# SECRECY AND SCIENCE

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## HEARING

BEFORE THE

## SUBCOMMITTEE ON CONSTITUTIONAL RIGHTS

OF THE

## COMMITTEE ON THE JUDICIARY
## UNITED STATES SENATE

EIGHTY-SIXTH CONGRESS

FIRST SESSION

(PURSUANT TO S. RES. 62, 86TH CONGRESS, 1ST SESSION)

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**PART 1**

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**A SURVEY OF THE EXTENT TO WHICH RESTRICTIONS ON THE FREE EXCHANGE OF INFORMATION HAVE IMPEDED SCIENTIFIC DEVELOPMENT AND PROGRESS**

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APRIL 28, 1959

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# SECRECY AND SCIENCE

**TUESDAY, APRIL 28, 1959**

U.S. SENATE,
SUBCOMMITTEE ON CONSTITUTIONAL RIGHTS
OF THE COMMITTEE ON THE JUDICIARY,
*Washington, D.C.*

The subcommittee met, pursuant to call, at 10:10 a.m., in room 1202, New Senate Office Building, Hon. Thomas C. Hennings, Jr., chairman of the subcommittee, presiding.

Present: Senator Hennings.

Also present: Charles H. Slayman, Jr., chief counsel, and William D. Patton, first assistant counsel.

Senator HENNINGS. The committee will come to order.

I would like to make an announcement at this time that Dr. Arthur Compton, who is scheduled to testify today, has been delayed because of bad weather and his difficulty in getting a taxicab to get here. He will be here, we have assurance by telephone, and we expect him in time, so we will stand in recess for a few minutes until Dr. Compton arrives.

(Whereupon, a recess was taken until 10:30 a.m.)

Senator HENNINGS. The committee having come to order, and with the appearance of our distinguished witness, Dr. Arthur Compton, we will now reconvene.

At the outset, without objection, I would like to place in the record of this hearing the official notice of the hearing which appeared in the Congressional Record.

(The notice of hearing referred to follows:)

[From Congressional Record, Apr. 28, 1959, p. 5783]

NOTICE OF HEARING ON SECRECY AND SCIENCE BY SUBCOMMITTEE ON CONSTITUTIONAL RIGHTS

Mr. HENNINGS. Mr. President, I wish to announce, as chairman of the Subcommittee on Constitutional Rights of the Committee on the Judiciary, that the subcommittee has scheduled a public hearing on the subject of "Secrecy and Science" on Tuesday, April 28, 1959, in room 1202 of the New Senate Office Building, Washington, D.C.

This hearing will deal with a subject with which the Constitutional Rights Subcommittee has long been concerned, the effect of undue secrecy on scientific development and progress in the United States. The subcommittee has been attempting to obtain the views of scientists throughout the country on this vitally important subject, and has scheduled this particular hearing in order to hear Dr. Arthur H. Compton, Nobel prize-winning physicist from Washington University in St. Louis, Mo., while he is in Washington, D.C.

Senator HENNINGS. If I may be indulged, I will make a brief opening statement.

This morning the Constitutional Rights Subcommittee will hold its first public hearing on a highly important phase of this committee's continuing study of the subjects of freedom of information and secrecy in Government. We intend to explore the extent to which restrictions on the free dissemination of scientific information may be interfering with scientific development and progress in the United States.

In the course of the subcommittee's work in the field of freedom of information, we have heard many complaints that undue secrecy has been hindering the work of our scientists and has even caused many young people to avoid science as a career. The aim of the subcommittee's present study is to seek the views of the scientists themselves to attempt to determine whether this actually is so and, if it is, to see what might be done about it.

I do not think I need spend much time elaborating on the great harm which could befall our Nation if we handicap our scientists with the shackles of undue secrecy. In plain and simple language, such a mistake ultimately could mean the difference between victory and defeat in our struggle with Soviet imperialism. In addition, by preventing the American people from receiving the information they need to intelligently exercise their rights and duties as self-governing citizens, excessive secrecy could help to undermine our entire democratic system.

A case in point which occurs to me as one that might be cited here is the manner in which information about radioactive fallout has been handled—some would say "mishandled"—by various Government agencies during the past few years. It apparently has been the policy of our Government, for one reason or another, to minimize the hazards of radioactive fallout. Rightly or wrongly, information about the effects of radioactive fallout has been withheld from the public, erroneous information from time to time has been given both to the public and to the Congress, and even contradictory reports have been issued about radioactive fallout and its danger to the health of the public.

Just recently a report was issued by the Public Health Service on the levels of radioactivity in milk collected during January 1959 from 10 sampling stations across the country. It so happens that my own city of St. Louis had the highest level of practically every one of the radioisotopes identified in the milk samples.

Being a citizen of St. Louis and a representative of the entire State of Missouri in the U.S. Senate, naturally I was quite concerned about this report and its meaning.

However, I have found it next to impossible to obtain accurate and meaningful information about this matter. I had no sooner begun to get straight in my mind what the Public Health Service's report meant in the light of the various permissible limits set for radioactive strontium 90 and other radioisotopes when the National Committee on Radiation Protection announced last Thursday that the permissible limit of concentration of strontium 90 in humans had been doubled, and that as a result the permissible limit of strontium 90 in water, milk, and foods had been increased by 25 percent.

I think we can all appreciate that the development of new and more accurate information might properly cause some of our Government agencies to revise previous estimates and figures, but the up-and-down, on-and-off manner in which some of the facts about radioactive

fallout have been handled in recent years demonstrates to me that this country's public information program about fallout is haphazard, confused, and completely inadequate.

National survival, whether it is based on defense against enemy bombs, guided missiles, or radioactive fallout, is the public's business, and the public is entitled not only to all the facts but accuracy in those facts as well. Some of us certainly think it is high time the American people are given all the facts about fallout.

During the course of its present study of secrecy and science, the Constitutional Rights Subcommittee hopes to obtain the views of as many scientists in as many different fields of science as may be possible, and, among other things, I would like to express the hope we will be able to obtain some accurate information about fallout, its hazards, and how far we have gone toward reaching permissible limits of safety.

As a preliminary step in the subcommittee's study of secrecy and science, I have written a letter to all American Nobel prize winning scientists, asking for their views. Many already have responded to this inquiry. As soon as all of their replies have been received and collated, they will be made a part of the record of these hearings.

This morning the subcommittee is privileged to have before it one of these men—one of America's leading physicists—Dr. Arthur H. Compton, who has graciously consented to appear before the subcommittee to present his views in person.

I might say that I realize that a short statement of Dr. Compton's achievements does not include a great many of the things that he has done in his very active and constructive and useful life.

I think most of us know that he has been an outstanding teacher and scholar in the field of science. He has been on the faculty of a number of the Nation's leading universities as an instructor and professor in physics.

Between 1945 and 1953 he was chancellor of Washington University in St. Louis, and now he is a distinguished service professor at Washington University.

Dr. Compton was awarded the Nobel prize in physics in 1927.

He worked prodigiously in his country's service both preceding and during World War II and was instrumental in the development of the atomic bomb.

In 1945, Dr. Compton was given the Medal for Merit by the President of the United States, the highest award given to a civilian by the U.S. Government.

Now, Dr. Compton, without imposing upon you any strain of being immodest, I think it might be appropriate for you to add what you might like to enlarge upon your special qualifications in testifying here this morning before a subcommittee of the U.S. Senate, and we would appreciate it very much if you would do so.

## STATEMENT OF DR. ARTHUR H. COMPTON, WASHINGTON UNIVERSITY, ST. LOUIS, MO.

Dr. COMPTON. Senator Hennings, it is a pleasure to appear before this committee in your discussion of freedom of information and secrecy in Government, because this is a topic that is naturally close to my heart.

It has been a matter of concern in most of my professional life and also in connection with my activities on behalf of the Government of the United States.

Senator HENNINGS. Dr. Compton, I might say that we feel that we are exceedingly fortunate in having you as the first witness on this subject. Not only do I claim you as an old and dear friend of many years, but I have had the pleasure of knowing your family for a long time. And I know what we in the St. Louis community have thought of you, and how you have been highly regarded not only as an educator and administrator and scientist but as a fine citizen of that community.

When you came to the university, you did not dwell in an ivory tower. You were part and parcel, and still are, of the life of the St. Louis community.

You have, as such, endeared yourself to all of us as a human being.

We also recognize that you are an exceedingly modest man. There are many who have achieved much less who do not have that same innate characteristic which you have so often—and, indeed, always—demonstrated.

So, Dr. Compton, without further preliminary, we would be very happy to have you continue in any way that pleases you, by reading from either such prepared text or such notes as you may have with you, and interspersing your own additional comments as you proceed.

We will try not to interrupt you by questioning you until you have made your statement, and then with your indulgence we will ask you a few questions perhaps in further elaboration.

Dr. Compton.

Dr. COMPTON. Thank you, Mr. Senator.

I might first just state why it is that I have been so interested in this topic.

In the first place, my professional work as a scientist and as a teacher has continually been concerned with the development of new knowledge and the extending of this new knowledge to students and to those who need to use it in connection with their growing activities. For that reason, for my own work and for the advancement of the work of those who are my associates, I have felt it highly important to consider the conditions under which new ideas can be developed most rapidly and effectively in the Nation's service.

In that connection, I have had to recognize the fact of both the importance of the growth of new knowledge, rapid growth of new knowledge, and also the importance of maintaining for the use of the Nation certain types of information that are of critical importance to the Nation.

This has involved both the problem of the secrecy and also the problem of the efficiency of the spread of information in order that it may grow.

So, as a student myself and as a person responsible for the development of science in the Nation's interest, I have thought that this problem is a very central problem in our activities and, naturally, have given considerable thought to the various aspects of the problem.

I would say that there are certain points that have impressed themselves upon me that I think are worthy of consideration.

May I refer first to testimony that I gave before your subcommittee in 1955, in which I was concerned with problems with regard to the

questioning of scientific men in their work and the results of this questioning that were at that time, 4 years ago, uppermost in my mind.

As I have looked over the record of that testimony as it has been supplied to me here, I find that the points that I was making at that time were, in my present judgment, points well taken and that they represented substantial difficulties and problems with which men concerned with the growth of science were concerned.

But may I say, in congratulating your committee, that the difficulties that I then saw have been, as far as I have been able to analyze them, all alleviated considerably.

Senator HENNINGS. That is very comforting, Dr. Compton, and it is very good to hear you say that.

We held some hearings during that period, as you well recall, in which you contributed vastly.

Among some of the things developed in those hearings, for example, was the interference with the attendance of some scientists, at international conferences by the refusal to grant passports.

I happen to think of Dr. Linus Pauling in that connection as being one, and perhaps the most outstanding, case. After he won the Nobel prize he was granted a passport. Theretofore he had the greatest difficulty and was, from time to time, delayed. I believe he was given a 6-month passport, but only after all sorts of limitations and restrictions and frustrating delays.

As soon as he won the prize, they were very happy to issue a passport and there were no further questions asked. He went to Sweden and received the prize from the King of Sweden, if my memory serves.

Then we found that there was considerable political screening of scientists applying for visas to enter this country, and there was a rather loose and spectacular and indiscriminate questioning of the loyalty of many, many scientists.

I would be very glad to have you, if you would care to and would, Dr. Compton, comment on these various points. You have already indicated that you think circumstances with respect to them have improved. I do not know to what extent this committee was responsible for that. I would like to think that we had some part in it, because we did hold extensive hearings, as you said, in 1955, in this very field bearing upon these various abuses.

Dr. COMPTON. I know, Senator, that there have been many different factors which have affected this alleviation of our situation of undue attention to secrecy. But I am confident that the activities of your committee have taken an important part in that alleviation.

One of the things that concerned me especially at the time was the fact that I had been engaged in several international conferences dealing with scientific matters and the problem was arising of the undue difficulty in arranging such conferences in the United States because of the difficulty of foreign scholars and men of science to come to this country freely through the barrier of visa examination.

That is an aspect which is additional to that of the difficulties of American scientists going abroad to get information which they might need.

This 4 years ago had become a matter of serious concern to those of us who were engaged in holding conferences of this kind.

As far as I know, those difficulties now have completely disappeared, and I am very happy to report this.

Senator HENNINGS. Thank you, Dr. Compton.

Dr. COMPTON. I believe that is the general sentiment of our scientific colleagues with regard to it.

Senator HENNINGS. It was almost a capricious denial in some cases, was it not——

Dr. COMPTON. I think it was.

Senator HENNINGS. Of passports and visas, not predicated upon any sound or substantial reason, and without hearings; indeed, without an opportunity for some of the scientists to even make a case. They were just denied or delayed. For one reason or another scientists were unable to either enter the country or leave the country.

Dr. COMPTON. There is another factor that has helped the situation.

At about that time, about 1955, for one reason or another, the State Department found it necessary to withdraw their scientific attachés from some of the foreign embassies, and that made it difficult to find a channel whereby cases could be appealed and considered that were of importance to those of us who were engaged in these conferences. I have been very happy to see within the past years the scientific attachés have been reinstalled, and I understand that this is a part of a firm policy, of the present policy, of the State Department. And I have every reason to believe that that is something that has been considered in association with the appropriate senatorial committees. I hope that this can be maintained.

Senator HENNINGS. Thank you, Doctor.

Mr. SLAYMAN. Mr. Chairman——

Senator HENNINGS. Mr. Slayman.

Mr. SLAYMAN. Dr. Compton, would you want to pinpoint what you think the reason has been for improvement in passport practices and procedures?

Dr. COMPTON. It is difficult for me to pinpoint it any more than to say that I have followed the cases of a number of individuals who have been engaged in getting passports or visas and found that they have come through more readily and with less what I might describe as capricious questioning.

Mr. SLAYMAN. I was wondering if you would relate it to the Supreme Court decisions of *Kent*, *Briehl*, and *Dayton?*

Dr. COMPTON. I should imagine that the Supreme Court decisions, which have made it necessary to have substantial reason to prevent the granting of visas or the granting of passports, have surely had a substantial effect in the easing of this situation.

The matter of requiring substantial reasons for denial of visas and passports seems to me to have been a very substantial advance.

I will point out also that this indiscriminate questioning of the loyalty of scientists has also been alleviated. However, the effect of these questionings in past years is still substantial.

I find that there are, particularly among younger men, doubts about the advisability of entering the scientific professions for fear that they will be considered as persons unloyal to the United States.

Senator HENNINGS. Do you find that still to be the case to some extent, Dr. Compton?

Dr. COMPTON. Yes. It seems still to be the case to some extent.

It is hard for me to measure exactly, but the opinion polls that have been carried on in high school groups have indicated that this impression still persists.

Senator HENNINGS. You would attribute that to a carryover, so to speak——

Dr. COMPTON. I think it is a carryover.

Senator HENNINGS. From those unhappy days when we were, without foundation and, as you have suggested, on caprice or whim or failure to properly investigate, refusing rather than taking a chance upon issuing passports or visas?

You would attribute that somewhat to our not having all the information which we might have had during that period of time?

Dr. COMPTON. This bears, in my mind, upon a point that I would like to lay a special emphasis upon this morning. That is the importance of relying upon those who are responsible for carrying on scientific studies or the development of science in the Nation's interest, relying upon these responsible individuals themselves for maintaining the essential degree of secrecy and security that is necessary in the Nation's interest.

Here is a point where I think a recent experience bears strongly.

There was a failure to recognize the fact that those responsible for such studies, as, for example, the directors of research organizations working for the Government or the presidents of universities who are concerned with the loyalty of the members of their faculties who are conducting research, are responsible to their superiors, whether they be, for example, the Defense Department or the trustees of the institutions, for the conducting of the research done under their auspices in the Nation's interest and, for that reason, must keep alert to the question of the loyalty of these individuals.

To my mind, a first approach to the question as to whether loyalty is being properly observed in research groups would be to see that this is looked into, for a group such as the Senate group, to assure itself at the beginning as to what steps are taken to insure the loyalty of the individuals working in these institutions.

That itself had not been the practice in, for example, congressional questionings of the period of several years ago and seemed to me to be an obvious lack of procedural, shall I say, protocol or much more——

Senator HENNINGS. Or a logical procedure?

Dr. COMPTON. Or logical procedure.

A point which I would like to emphasize today is the importance of putting the responsibility for loyalty and maintenance of appropriate security in the hands of those who are responsible for conducting research. This would apply not only for research which is my own special interest but, as far as I can see, likewise to such matters as conducting the work on the national defense or on the international policy of the United States.

I do not see how one can effectively assign a job to be done to groups without putting in the responsible hands for conducting the work also the responsibility for seeing that security is adequately looked after.

It seems to me a problem that is all in one piece.

Senator HENNINGS. Forgive my asking this question. I hope it does not disturb your train of thought Dr. Compton. But would you be good enough to give us your general views on the role of the

scientist today not only as it affects national security but as it affects our society as a whole?

This is a broad question.

Dr. COMPTON. Well, my general views on that are to be expressed this way: That I believe the total development of an industrial society such as is that of the United States is very greatly affected by the development of science.

One way of indicating that is, for example, the measure of the number of telephones that are being used or the rate of increase in the use of electric power, which are measures of the development of our technological advance, are increasing at roughly the same rate as the increase in the employment of scientific men in industry. That is roughly doubling every 10 years. These things go closely together.

That is just one kind of quantitative correlation that suggests what is otherwise also rather obvious—that the advances in our social—I suppose you can call it progress although some might question whether the progress is forward or backward—are determined to a very substantial extent by the growth of our scientific knowledge.

If that is true, then the place of our scientists in society is a very important one, and the cultivation of their work becomes correspondingly important.

I could expand on that in several directions, but that is sufficient.

When you come to the more particular questions, as for example, of national defense, it becomes clear that the recent changes in our defense planning with regard to techniques of, well, shall I say, the tactics and the strategy of defense, are determined to a very large extent by the types of new weapons that are available, and these are in turn dependent very largely upon scientific advances.

And if that is true in defense, it is likewise true in industry.

Senator HENNINGS. Thank you, Dr. Compton.

Is it not a fact, Dr. Compton, that ultimately all of mankind and not just our scientists benefit from the free exchange of scientific information?

Dr. COMPTON. I do not think that the scientists are uniquely or even especially helped by science as compared with other people. The obvious development of industry under the influence of science is one that affects all of us.

Senator HENNINGS. Certainly in many material respects the scientists are the least of the beneficiaries.

Dr. COMPTON. I would say in this regard the scientist is especially helped, and that relates particularly to the free flow of information. Since time immemorial one of the best methods of the advancement of knowledge has been free discussion among men. This, from the time of Socrates on down to the present time, has been recognized as one of the most effective methods of arriving at truth and of testing truth, checking one person's thinking against another's.

This has resulted not only in the improvement of the reliability of information that is brought forward but also in the suggesting of new ideas and interchange of discussions.

This, to my mind, is a place where science is especially dependent and especially sensitive to the free flow of information.

In that regard, the scientist is a special beneficiary of any freedom that may exist in the flow of information.

But, as I mentioned before, what benefits the scientist in this regard is reflected very quickly in the very material benefits that come to the whole citizenry.

Senator HENNINGS. Dr. Compton, may I ask you if you think it is realistic or useful to attempt to impose secrecy on scientific information beyond the relatively small area of weapons technology?

Dr. COMPTON. In certain cases it may be. But I would point out that in such cases it should be the responsibility of those who carry the responsibility for the advance of science.

Let me give a couple of examples.

I will go back first to Francis Bacon in his book "The New Atlantis," in which you may recall he had his society dependent upon, largely dependent upon, a scientific, or what would now be called a scientific, research institution.

In this scientific institution the members of the institution took a pledge to reveal no secrets except those that it was agreed upon would be in the public interest to reveal, and some of these would not even be revealed to the state. It was assumed that the members of this group that constituted the research institute were themselves loyal citizens of the state and could be relied upon for keeping that information which was best in the community interest revealed to the state, making that available, and other information they would keep to themselves.

Now let me give a modern illustration of that which came to attention not many years ago when the fission of the uranium atom became known among scientists. It became apparent to the scientific group that if along with the fission of the uranium atom there would be more than one neutron emitted, new neutron emitted, there would be the possibility of a nuclear chain reaction.

When experiments began to be done in that field, there were a group of American scientists headed by the scientists at Columbia University who saw that it would be a very dangerous matter to have the information become publicly available; that a chain reaction could be produced. They felt that it was highly important that this be kept, at least for the time being, in the hands of the scientists themselves until some consideration could be given as to how that information could best be used.

So this group of scientists, particularly the physicists at Columbia University and Princeton, made a pact among themselves and obtained a rapid spreading of the agreement to join this pact to withhold information that might have bearing on the national defense until some consideration of it should be made.

Now, this was done even though it might hold back the speed of advance of the information with regard to nuclear science because it was felt that this might be of danger, that the openness of that information to other nations might endanger the safety of the United States.

As a matter of fact, the result of this secrecy pact, which was held quite strongly and well in the United States, did have the effect of slowing down the advance of the associated science of nuclear physics—and with some dangerous possibilities that, for example, in certain fields other countries went ahead more rapidly than we did until that secrecy ban was removed.

This, I would note especially, was a secrecy ban that was instituted by the scientists and maintained by the scientists without any reference, without any suggestion even by the Government, from the Defense Department or any other part of the Government. It was because of the recognition by the scientists themselves that they were dealing with material which might be—which was certainly—of concern to the public and might be dangerous to the safety of the Nation.

Now, eventually the information of importance which the American scientists brought out, namely, that there was a multiple number of neutrons released in the fission process and which made it evident that a nuclear chain reaction could at some stage be achieved—was not maintained secret, not kept within the bounds of the United States for any great length of time before it was discovered independently in France and published, and at that stage it became useless to try to hold back the information in the United States.

The information then became open to all. And it was at that stage, approximately at that stage, that the possibilities of atomic energy becoming an important matter in the national defense became apparent and the resulting development of what became the Manhattan project.

I bring that out for several reasons, one to indicate that the matter of secrecy is of concern, of special concern, to the scientists themselves, and also the fact that the scientists are accustomed to recognize that the questions of national interest are a matter of prime concern to science as well as to the public.

Now, again I would point out that I am concerned with the place where the responsibility lies for achieving what is in the Nation's interest. In science it is the question as to the responsibility for the advance of scientific knowledge.

In the case that I just mentioned, of the development of scientific knowledge of nuclear physics as a matter of concern to the national defense, it became apparent to some of the American scientists that the secrecy that was holding back the spread of our information among ourselves—by "ourselves" I mean among the American scientists—was preventing the development of the science and that it was therefore becoming dangerous to the welfare of the country that we were having this undue level of secrecy.

The pressures developing within the scientific fraternity itself became such that it became generally agreed that we would have to release that information and make it more public, at least within the scientific group.

It was at that stage that the advance of our scientific knowledge became possible.

But this is again a question that I would like to develop in a different direction; namely, in the direction of the importance to the Nation of having open information within a rather broad field.

The prime example that I would like to give of the importance of this openness of information is the U.S. patent system.

The U.S. patent system may be considered as reaction against the traditional guild idea of maintaining secrets within a guild. These are technical secrets of the kind that are involved all the way from industrial secrets to medical secrets.

The important advance in which the United States was not first but nevertheless carried through the advance to a very marked degree was in the establishment of the patent system.

A patent viewed from this point of view is essentially a contract between an individual and the Government that the individual will make available the secrets on which he is operating in return for the guarantee of a 17-year monopoly for the development of those secrets. For a 17-year period the individual thus gets a real advantage in protection of his monopoly, but after that it becomes an open secret which anyone can use.

The advance of industry, of medicine, and of all aspects of applied science under that system of the patent regime is remarkable.

I think this is the thing that illustrates the wisdom of those who started this U.S. patent system, and it has shown the great value, the great public value, of a system whereby information is made open and an individual or a company, a corporation if you wish, is recompensed, is paid actually, for releasing secrets in the Nation's interest.

It indicates, I think, a presumption that that openness of information is valuable to the public as well as to the individual.

This has been a matter that has been a little difficult for people all the way from individuals who have private secrets which they are exploiting, to the Government in connection with its national defense—it has been difficult for all parties concerned—to appreciate that secrets are not ordinarily the best means of protecting the interest of the group concerned.

I have been especially interested in connection with the development of secrecy and openness of information in industry, industry particularly that depends upon patents and scientific information. The development of the patent system went a long way in making it profitable for an industry to make publicly available the "tricks of the trade" that they had available that helped them advance but did not go the whole way. There have always been technical secrets of manufacture and so on that have been guarded in the company's interest.

But, in spite of this, over the last two generations especially, there has grown a gradual appreciation of the fact that the growth of the company is best helped by getting its technical men in association with technical men of other industries and other groups in order that they can compare information.

This has been the cause, for example, of the development of such organizations as the American Institute of, shall we say, Chemical Engineering, or Electrical Engineering or Mechanical Engineering, where individuals concerned with the same type of problem get together, discuss their mutual problems, the techniques that they have found of importance in answering their problems, with the result that all of the industrial organizations associated with that particular type of engineering have found it possible to grow more rapidly. This has been found of more value to them than the attempt to guard with special tightness the technical secrets that they have in hand.

This, I think one will find that the industries will agree, has been one of the very important developments in national industrial relationships during the past couple of generations.

Now, I have given that particularly with reference to the matter of industrial secrets. I can go back and relate it to the question of scientific advance.

Fifty years ago it was the common practice in science for a man to put a trademark, so to speak, on a certain aspect of science which he himself had started to investigate. If he would publish a paper, it was notice to his scientific colleagues that this was his little private province and that other people should keep off the ground and let him develop it and see what he could do.

This is a point of view which has almost completely disappeared within the last generation. And it has disappeared because it has been found that the speed of advance has been much greater when a number of people approach the same problem from different points of view and compare ideas so that each can contribute, can fill in gaps in the other person's information, and thus the information grows more rapidly.

This has been found mutually so advantageous that it has become the modern pattern of science, and the openness of information in science is a part of this same process that has been going on with the development of patents in industry and so on.

It has come in recent years, since World War II, also into the field even of national defense, which is perhaps the most sensitive field that we have, where the present standard is generally accepted that the things of fundamental scientific interest, meaning by "fundamental" science the science which is basic to the development of various aspects of weapons, will be made open, but one will retain for one's self, that is, for the welfare of the Nation, information with regard to the particular methods of application of this scientific knowledge which would involve special techniques for development of weapons or development of tactical use of weapons and things of that kind. These are things which are of such immediate importance to the Nation concerned that they will be maintained.

But it is found profitable to compare notes on the broader level so that one's own scientists can make sure that they have available the best of modern information as they compare what they have with that which people in other nations have.

Senator HENNINGS. Well, Dr. Compton, if I may ask this question, it will perhaps lead you into a discussion of other aspects of this.

Of course, we all know that we have to use the greatest care in protecting basic military secrets, and I do not think any of us who have the national interest and security in mind would believe in eliminating all secrecy requirements, but at the same time is it not generally agreed that scientific development and progress is most likely to occur in an atmosphere of freedom?

Dr. COMPTON. That is true.

Senator HENNINGS. With the free exchange, of course, of information, as you have suggested, and ideas.

Now, in view of this, Dr. Compton, does not the overall problem here resolve itself to a great extent to deciding what must be kept secret for military purposes or in the national interest, and removing all restrictions on all other scientific information?

Dr. COMPTON. I think that does describe rather well what it is.

A point that I would like to add to that, however, Mr. Senator, is that new problems are continually arising which have not been covered by considerations that have gone before.

The example of nuclear fission is one in point, where, whatever may have been decided upon before as to the exchange of informa-

tion, here is something new that was not considered as the rules were drawn up. And at that point it is necessary to depend upon the loyalty and the wisdom of the people who are responsible for carrying on the investigations—in this case of nuclear fission—for handling wisely in the Nation's interest——

Senator HENNINGS. Yes.

Dr. COMPTON. What they do with the new information that they are bringing.

This is why I would like to come back again to the point that putting the responsibility for maintaining security in the hands of those who are responsible for seeing that a job gets done is the prime guide, I should think, the prime principle on which this should be handled.

Senator HENNINGS. By that you mean the officials of the universities——

Dr. COMPTON. Or shall we say the officials of the Defense Department.

Senator HENNINGS. Or the Defense Department, or the given industry which may have a grant or a contract engaging in research, experimental, and developmental work?

Dr. COMPTON. Yes; that is exactly what I mean.

Now, there is one precaution there. I have sensed throughout a long life that each particular group in society feels that it has a sort of priority on loyalty to the country. And this is obviously one of those things that is not true.

One can understand how this is, for example, with a member of the Armed Forces who takes a loyalty pledge to defend the Constitution of the United States, and that has brought sharply to his attention the fact that he is responsible for defending the Nation. And he is apt as a result of that to feel that he has a guaranteed loyalty to the country which a Senator of the United States, who has not in the same sense necessarily taken that pledge, is not feeling.

One forgets in that case that a man in political life has devoted himself to the welfare of the country. That is what he is living for.

And in the same sense the person who is responsible for education has devoted himself to the growth of young men and young women, is likewise concerned with the growth of the country.

And it applies to every profession that we consider an honorable part of the professions in the Nation's interest.

Senator HENNINGS. You do not think, Dr. Compton, that teachers would be likely to be more loyal if they had to take loyalty oaths?

Dr. COMPTON. I do not at all. If I were a person who is disloyal to the country—God forbid—I would say that——

Senator HENNINGS. That you would be very happy to take any oath?

Dr. COMPTON. Taking a loyalty oath would be one of the first things I would be willing to do.

Senator HENNINGS. It seems so self-evident. There has been a great deal of talk about it.

We lawyers remember one of the leading cases, the Jehovah's Witnesses case in California back in the early 1940's, where ultimately the Supreme Court held, as you will recall I am sure, that the people of this religious cult or sect were not to be required to salute the flag

because it was inimical to their fundamental, basic religious understanding.

Of course, those of us here in the Senate and the House of Representatives do take an oath to defend and protect the Constitution of the United States. Those of us who have been in the military service have taken the same oath. But I presume such an oath technically would probably last only for that period that you are in the service. I do not know that that point has ever been raised.

Dr. Compton, is it not a fact, too, that to some extent all areas of science do have military application or potential military application of one sort or another, so that if military use or potential military use is used as the only standard for determining what shall be classified, then practically all scientific information might be classified? And if this is done, would it not to an even conceivably calamitous extent impair all scientific progress and development in the country?

Dr. COMPTON. I think that is absolutely true.

If one had asked a generation ago what was the defense importance, shall we say, of physics, it would have been difficult to point out except in minor, isolated examples as to how physics might have been concerned with the national defense. There would be an obvious answer to that now from many different points of view.

But this can be said of any particular field of science, even, shall we say, that of archeology, or I am thinking, of paleobotany or zoology, where you are concerned with the knowledge of fossils. Even that kind of thing. One can imagine how this might become of really substantial importance in connection with problems of defense.

Senator HENNINGS. I remember, Dr. Compton, being on the Foreign Affairs Committee of the House of Representatives back in the 1930's, preceding the World War. During Benito Mussolini's Libyan venture and invasion we came to consider the proposition of applying certain sanctions. One was oil. And we got down to other propositions. Then later came the Neutrality Act in 1939, where it was forbidden to ship to any belligerent arms, ammunition, or material of war.

And you get into the vast question, which seems to have an obvious answer in modern war, that virtually everything is to one extent or another materiel of war in the broadest sense.

Dr. COMPTON. Even food.

Senator HENNINGS. I was about to say, that is certainly true of foodstuffs.

Certainly during the American Civil War it was true of medicines; quinine, notably, because of the extent of malaria in the South at that time. Such things were in short supply and, indeed, even altogether lacking. It was a very serious problem.

And so it goes. And food, in those days, too.

Dr. COMPTON. I would like to go back to the question as to the unique place of defense problems as to the requirement of secrecy. This brings to my mind the fact that so far as even the defense of the United States, as meaning the security of our country, there we are concerned not only with, shall we say, arms and weapons, but we are concerned likewise with the strength of our neighbor nations, particularly of our allies, and those that are associated with the free world.

I would say in that regard that our national defense, therefore, depends in my mind upon the strengthening of the entire free world and anything that affects the strength of the entire free world affects likewise our problems of national defense.

When one thinks of it from that point of view, it becomes obvious that those who are concerned with the safety of the Nation are likewise concerned with all of the problems associated with the development of society which says that any aspect of science is of bearing on this.

This is one of the reasons why I would say that in enforcing or developing the principles of a security system, the reliance has to be on the individuals, the wisdom and the loyalty of the individuals, who are concerned with carrying out the projects for the development of the Nation.

Senator HENNINGS. Yes. And it should not be indiscriminate, superficial inquiry or accusation here, there, or the other place, which tends to inhibit, which tends to frustrate, which tends to discourage so many men and certainly women nowadays in scientific pursuits.

Dr. COMPTON. Might I just illustrate that? One of the real difficulties that has come in connection with the development of the scientific aspects of national defense has been the question of clearance for work on something.

This has become really a highly organized—I think I would describe it as a "bureaucratic" matter, in which there is a significant part of the responsibility put in the hands of bureaus which have their own interests involved quite independent of the interests of advancing the scientific knowledge that may be the concern of groups.

The result is that if an individual is already, shall we say, engaged in scientific studies in a defense department on the east coast, and if it seems desirable for the progress of the studies for this individual to be transferred to the west coast, it takes a long time for the clearance that he has on the east coast normally to be made available to him for work on the west coast. And this is——

Senator HENNINGS. Of this same country?

Dr. COMPTON. Of this same country.

Senator HENNINGS. That exists today?

Dr. COMPTON. That exists today; yes. This is the kind of problem, this is the kind of thing which I am pointing at when I say I think the responsibility for the security problem must be in the hands of those who are responsible for getting the job done.

Senator HENNINGS. If it is necessary, Dr. Compton, in the national interest, for the national safety, that a man or woman be transferred from New York to Los Angeles, and if time is an important factor or element in this development, whatever project it may be, there is likely to be considerable delay between what might ordinarily be a 6-hour airplane flight to the west coast and the time that person must await clearance once he reaches the west coast to go to work?

Dr. COMPTON. I would take this as a typical example: Suppose a man is employed by the National Bureau of Standards on study of a problem in radioactivity. He will presumably have been cleared for work on this problem in Washington on this job. We may well suppose that in Los Alamos there comes to be a problem which needs investigation by a person of his ability, and the director of the Los

Alamos scientific laboratory makes arrangements with the Director of the Bureau of Standards to have this man transferred.

But before he can be transferred, he will have to go through channels of clearance which will involve perhaps many weeks before the transfer can be made. And it may well be that his usefulness is over, that the job which he was supposed to do will already have been done by some other method with the expenditure of considerably more time and effort.

This is the kind of thing to which I refer as the security techniques frequently destroying their own objective, because they become too highly organized.

This seems to me to be at the moment one of the major problems that we face as a nation in connection with the security problem—namely, making it possible to make available to the part of the Nation involved the skills of people in other parts of the Nation, but, more generally, developing our security system in such a way that the essentials of secrecy insofar as they are essential can be maintained while transfers are made of individuals from one place to another for work.

Senator HENNINGS. Would that not seem to indicate, as you have said, Dr. Compton, the need for better organization of the security system and also a greater centralization of it?

Dr. COMPTON. A greater centralization, but with this thing kept in mind: That the responsibility for getting the job done is the thing that must be maintained as the matter of top importance.

The difficulty that I see there is that frequently the responsibility for maintaining secrecy is put ahead of the responsibility for getting the job done, so that the individual who is, or the office, shall I say, rather than the individual, that is responsible for maintaining secrecy may make it impossible for the office responsible for getting a job done to get its work accomplished.

I think this involves an organization where the first priority is put on getting done the job that is considered in the Nation's interest. I would personally like to see an office of security so developed that it can be used as a source of reference and advice to the individuals who are concerned with getting jobs done, so that——

Senator HENNINGS. In the nature of a general clearinghouse for secrecy and security?

Dr. COMPTON. And authorization and counsel, shall we say. Because it is necessary. There are those, who have had experience with the developing of secrecy, with know how to do this in such a way as to interfere less than a secrecy development which is set up without consideration of previous experience. I have seen that happen.

I know that those who are skilled in the art of maintaining security with the Nation's interest at heart can accomplish the essentials of security more efficiently than those who take it without such experience.

So if we put the responsibility for maintaining appropriate security in the hands of those who are responsible for getting a job done, they should have available to them the counsel of those who are experienced in the techniques of security.

Senator HENNINGS. And would it be going too far to say, in the light of that, Dr. Compton, that in many of the installations, projects,

or at least in some of them, the matter of security is in the hands of amateurs——

Dr. COMPTON. That is true.

Senator HENNINGS. Who do not know very much about it and who take a great deal of time, probably, in learning very little, when a thorough and complete security check has already been made?

Dr. COMPTON. Let me take an example. I was for a number of years the chancellor at Washington University. I would have the problem of maintaining an adequate manner of insuring myself of the loyalty of the people who are working on problems, especially the sensitive problems of national defense, in my university. And yet I want to have this matter of maintaining my own confidence of the loyalty done in such a way as to interfere as little as possible with the free flow of information.

Now, how am I to do this?

I may as the chancellor of the university have had some experience in that field, but I would feel greatly strengthened if I had available the professional counsel and advice of people from security organizations such as the FBI or the military intelligence or groups of that kind who have been accustomed to dealing with this problem. But I would feel, nevertheless, that I am in a better position than they would be to weigh the evidence in one way or another with regard to the specific individual in my own university as to whether these are persons on whom I should rely or should not rely in maintaining my organization.

So this is the kind of thing that I would illustrate. But it applies not only within a university; it applies likewise to industrial research organizations and any other group that you may think of.

Senator HENNINGS. Yes.

Dr. COMPTON. Even within the Army itself.

So it would seem to me that, to come back again even at the cost of repeating a fact, the important thing is to put the responsibility for seeing that the appropriate techniques of security are maintained in the hands of the person responsible for getting the job done, but that he should have available to him as a service organization, if you wish, the counsel from the security organizations that the Government will have developed here and there.

Senator HENNINGS. Yes.

Dr. COMPTON. I am trying to indicate that there is a place for a bureaucratic security kind of thing, but it should not be in the dominant position. It should be in the position of a service role rather than of a determinant.

Senator HENNINGS. It is really collateral, is it not?

Dr. COMPTON. Yes, it is.

Senator HENNINGS. When you get down to it?

Dr. COMPTON. I think that is correct.

Senator HENNINGS. Essential, but collateral?

Dr. COMPTON. Yes, I think that describes it accurately.

Senator HENNINGS. Dr. Compton, do you not agree that, aside from impeding scientific development and progress, undue restrictions on the dissemination of scientific information may also violate the people's right to know, if we may use that phrase, by keeping from them information that might be necessary before they can intelligently exercise their own right of self-government?

Dr. COMPTON. I am sure that that is true.

Senator HENNINGS. Without the facts, we cannot, in the highest sense, have a self-governing body politic, can we?

Dr. COMPTON. I think that is true. I am sure that is true.

Senator HENNINGS. I am not talking about secrets relating to national defense, of course.

Dr. COMPTON. There is one problem that you referred to in your first statement, Mr. Senator, that I would like to comment on in that regard. That is, for example, the question of the information available concerning fallout.

Senator HENNINGS. I am very glad that you mentioned this fallout question, Dr. Compton, because I was going to try to get to it. It has been very disturbing to all of us who know nothing about it except what we read—and we read and are confused indeed, by one authority after the other. We do know in our own city of St. Louis we were said to have had the highest percentage in the Nation in the milk.

Dr. COMPTON. Yes.

Senator HENNINGS. What are we to believe about that, Dr. Compton? What can and should the people do? What can and should the Government do?

Dr. COMPTON. Well, may I explain that? One of the real difficulties here—and this is a problem, may I say, in which I have a certain but not very high degree of professional competence. It is, however, something with which I have been associated since the beginning of the problem. I have naturally followed the question of the fallout because it has been a part of my past experience. A major part of the difficulty in this regard is the fact that the scientific information is only gradually being accumulated and is not yet adequate to give precise and sure answers to the different questions concerned.

This relates particularly to the matter of the question of what is the allowable amount of strontium 90 that the human body can safely tolerate?

As I look back in my own experience——

Senator HENNINGS. Is the question as to strontium 90 being cumulative in the bone marrow, for example, one phase of this?

Dr. COMPTON. Yes. And one of the particular points here is the question as to precisely where in the bone does the strontium accumulate.

It was assumed to begin with that strontium in the bone would have the same type of physiological effect as would radium in the bone, and yet when one investigates it more closely the two are not strictly comparable, because the action of radium is due to alpha particles which are particles whose action occurs within a very small distance from the point of the radium, a matter of fractions of a millimeter, whereas in the case of strontium the physiological effect is due to beta particles that are emitted by the strontium, and the range of the beta particles in human tissue——

Senator HENNINGS. That is theta?

Dr. COMPTON. Beta. The range of the beta particles is roughly 10 times as great as that of the alpha particles. This makes a substantial difference in the range over which the damage is done.

One cannot compare directly the effects, therefore, of radium with those of strontium.

It is a gradual appreciation of this difference which has not even yet been thoroughly checked by experiments on animals that has led to uncertainty as to just what the amount of damage to be done by strontium is, even though we have pretty good evidence on the damage that is done by radium.

Senator HENNINGS. Well, Dr. Compton, most of us, of course, are infants in terms of discussing such matters or having any knowledge of them. We are untrained. We have no knowledge of the factors involved, of the accuracy of the reports we are given.

Some very alarmist statements are made about them. I should not say "alarmist." Perhaps "alarming" is a better word.

But what should we do about this, in your opinion?

I have people every day ask me, "How about this fallout? What is it doing to our children? What is it doing to the next generation?"

Strangely, they do not seem to be so much worried about themselves as they are about their children—and that is not so strange, either.

But what are most of us, who are not trained in science or its application, to say and do about it?

It is a problem I think that has been very disturbing to some of us here in the National Government.

Dr. COMPTON. Well, now, it seems to me that you have put your finger on the one essential point—namely, that what information there is should be made available. And that means freedom of information.

But I would likewise emphasize this: It has long been recognized within the medical fraternity that it is unwise to put forward information that has not been thoroughly verified, because it leads to unnecessary hopes or unnecessary fears.

Senator HENNINGS. We, of the laiety see this day after day, just as some of us who by profession are lawyers see extreme, sometimes absurd, statements made by lawyers. We have some basis for judging those things. We see many doctors going to medical conventions and meetings issuing statements or making speeches seemingly, obviously, intended for front-page treatment by the newspapers.

Dr. COMPTON. Yes.

Senator HENNINGS. Dr. so-and-so, who has never been heard of before, has discovered that thus-and-so causes this, that or the other thing.

There was an article in one of the newspapers here the other day about the soil and runoff of water up near Hagerstown, Md., as bearing some relationship to cancer.

Now, the newspapers are replete, it seems to some of us, with these statements and theories and views of one group or one individual or another. And I think the average man or woman in today's uncertain and somewhat tenuous state of existence is constantly being bombarded by pseudoscientific statements—to use the common parlance, half-baked medical pronouncements. You begin to think, "What on earth is happening? Whom are we to believe? Where is the truth?"

Now, the other day the Washington newspapers—at least one of them I recall—headlined that St. Louis had the highest percentage of radioactive isotopes in milk. And so it goes.

As a scientist to a layman, you have already partially answered that question, but what are some of us who are charged with the responsibility to say?

A woman comes to me and says, "Why don't you do something about this fallout? It is going to ruin, destroy our children in generations to come."

"What am I to do? I don't know anything about it."

"Why don't you know something about it? Isn't that part of your job?"

"Well, we're trying to find out."

"Well, it's about time you found out, isn't it?"

How can we find out? We find out from the newspapers, the magazines.

Dr. Compton. May I suggest that——

Senator HENNINGS. I have not had it suggested quite as bluntly as that, but I am sure a lot of people think about that and wonder, "What are you fellows doing up there? Don't you know anything about what is going on?"

Dr. COMPTON. May I remind the committee that there exists a scientific adviser to the Government in the National Academy of Sciences and that one of the standard and probably wise procedures in the present case, where there is so much uncertainty on the scientific basis, I should think would be to ask the National Academy of Sciences to take this matter under advisement and report back to the Government perhaps at regular intervals in the present case.

Senator HENNINGS. Do you know whether that has been done, Dr. Compton?

Dr. COMPTON. I know the problem is at a certain stage of consideration, but——

Senator HENNINGS. Yes.

Dr. COMPTON. But I do not know exactly what the stage is.

At the moment I do know the National Academy of Sciences has the question of fallout under study, and its implications, but I do not know how thoroughly or into what aspects it has gone.

I should think a discussion, for example, between your committee and representatives of the Academy as to what kind of information it would be possible to put into the hands of the public and into the hands particularly of the Government might be a wise procedure.

Senator HENNINGS. I appreciate that suggestion very much, Dr. Compton, and I assure you that we will pursue it.

Dr. COMPTON. I can assure you——

Senator HENNINGS. I am aware that there are not any final answers to many questions in an age of accelerated scientific progress and growth, just as we are aware here that there are a good many problems that may be indeed insoluble in our time.

It is the American habit of thought, it seems to me, to think of most problems and questions as being necessarily soluble in our time—that we have got to solve this, if not tomorrow, next week, or within some period of time.

It seems to me more and more as I go along in Government work that a lot of things do not lend themselves to absolutes. Certainly this may be one.

Dr. COMPTON. Mr. Senator, if I may divert attention for the moment to just a little aspect of this of which you are speaking, I would like to call attention to the fact that in this matter of fallout and its effects, there are problems associated with human genetics. And these are problems which take generations to solve.

Senator HENNINGS. Yes.

Dr. COMPTON. That this was true was recognized by those of us who were concerned with the development of the atomic energy problems back as early as 1941.

We initiated at that time a very intensive program of study of the effects of radiation particularly with relation to genetics, realizing that this is something that should have been started years before but that there was nothing one could do better than start it at that time.

This work has been carried on by the Atomic Energy Commission following the development that I initiated under the Manhattan District in 1941 and has been going on for some length of time.

But it still requires generations to get the work done, and, as you say, you cannot get the answers now, but you can get as good answers as you know how to get at the present time, and that is the best we can do.

I would likewise emphasize a point which you have already brought out, that in questions of this kind there are frequently special interests involved, as, for example, in the importance of a news story as exciting the public interest or the advance of certain particular interests of, shall we say, even international political type that are involved. These may serve to distort even interpretations of scientific results.

These are things which make it necessary, as you have already indicated, that the scientific information that we collect and give to the public shall be as far as is humanly possible free from bias and represent the wisest conclusions to which we can come.

Senator HENNINGS. Dr. Compton, to turn to another matter, there is much discussion in the press about Project Argus—during which, as you know, three atomic bombs were exploded at an altitude of some 300 miles. These detonations took place last fall I think.

As I understand it, they were highly classified and not made public until the New York Times printed a story about them approximately a month ago.

Dr. COMPTON. Yes.

Senator HENNINGS. Now we have heard a good many comments, all of us, about the Project Argus, ranging from the statement that it represented just another example of needless and useless secrecy, to the statement that the revelation of the information about Project Argus was a breach of security.

Do you feel that you are free or would you care to comment at all on the Project Argus in connection with our present discussion of secrecy and its relation to science?

Dr. COMPTON. Mr. Senator, may I comment that with regard to the Project Argus, I will have more information after certain papers are read at the National Academy of Sciences tomorrow morning.

But at the present I will have to answer on the basis of what I happen to know, and a part of this has come from classified sources, but I will do my best to state what I can in connection with it. I do not think there is anything that I have that will be itself classified in what I shall be saying here.

Senator HENNINGS. I am sure we trust your judgment as to that, Dr. Compton.

Dr. COMPTON. In the first place, so far as the scientific side is concerned, there was very good reason for hoping that the explosion of these bombs at high altitude might give information that would be

important from a defense point of view. As it turned out, the importance from the defense point of view was perhaps such that the hope there was too high. But from the scientific point of view the experiments have given a remarkable amount of useful information in the development particularly of the science of cosmic rays, which is something with which I myself have been associated, and that will form an important part of the discussion at the National Academy of Sciences tomorrow morning.

With regard to the question of security breaches, possible security breaches, I do not know enough about the technical aspect of that to know whether it was a breach of security or not.

But I do know that from the point of view of the international political situation it was a matter which was very sensitive indeed, and it would seem to me to have been extremely unwise for the newspapers to have released this story without consulting thoroughly with the State Department and the Defense Department before.

Senator HENNINGS. For clearance?

Dr. COMPTON. It has been the custom of many of us associated with problems of this kind to deal with the newspapers on a matter of mutual confidence, under the understanding that the newsmen, who eventually must make use of the information, are kept informed as to what is going on, with the idea that the information will not be released until it has been approved by the appropriate authorities that the news should be released.

Without knowing the details of the present situation between the sources and the newsmen themselves, it would appear that this news break occurred at a time which was somewhat premature for the interests of those concerned in the Government.

The fact that there was something here of real importance is obvious from this: That there was a test of atomic bombs made at a time when the nations were alert to the fact whether such tests could be detected was important. And the fact became apparent that tests could be carried on above the atmosphere in such a way that they would not be detected, that they actually were not detected, by other nations.

That itself was an event of substantial interest and bearing on the question of the detectability of tests which is at the time under discussion at Geneva.

So the fact that this was a matter of some international importance in our international procedures was obvious.

Might I add at this point, not touching directly on the question of the Argus tests, I have had a feeling that one of our major problems with regard to national security is that of persons associated with collecting of news or who are concerned with writing of interesting articles or books. There has seemed to be a kind of game going on analogous to a chess game, in which the writers are interested in seeing what they can interpret out of published information in the way of the aims of the Defense Department or of the State Department, taking what published information—and, therefore, declassified information—leads in the way of implications to the purposes of the Defense and State Departments.

This seems to me to be a very dangerous sort of game. And a reason why it is dangerous is this: That those involved in carrying on the game are themselves experts. They are always men who have

had a good deal of experience in political or defense matters and very frequently have had contacts, have actually been in places where they have used classified information not generally open to the public. They may not consciously realize that they are making use of that classified information but cannot actually avoid having their interpretations make use of that kind of information.

Senator HENNINGS. Do you not think, Dr. Compton, that one reason some of us would rather not have possession of secret or classified information is that we might predicate certain statements or arguments on the Senate floor on such secret or classified information? The human mind at the time might not be aware it is using something that was developed as a result of secret or classified information?

Dr. COMPTON. I have myself——

Senator HENNINGS. It is sometimes hard to draw that fine line. It is very difficult.

Dr. COMPTON. I have myself at times avoided getting classified information in order that I might be sure that I do not use it——

Senator HENNINGS. I am sure you have.

Dr. COMPTON. Without understanding. So I understand what you have in mind.

Senator HENNINGS. Having known you for so long, I know what an exceedingly careful man you are.

But putting such information in the hands of men who cannot always delineate between what they have heard as a matter of rumor and what they have learned in confidence is a difficult thing, is it not?

Dr. COMPTON. It is.

Senator HENNINGS. It is almost asking too much of the finite mind to confine itself strictly. When you know a fact and also something that is secret that completely demolishes that fact, you have quite a problem.

Well, Dr. Compton, I know that you have a 12:30 lunch appointment. And I realize that we could, with the greatest profit and advantage to ourselves and for the record of this committee, listen to you discuss the matter for many, many hours and for many days, and still continue to learn and to be enlightened.

But bearing in mind your own commitments and your generosity with your time in coming here during the meetings of the society which you are now attending, may I ask you, sir, if you would like to sum up or if there are any other points, and I am sure there are a number, that you would be good enough to illuminate for us and discuss for us. We do not want to impose upon your time.

Dr. COMPTON. May I then, Mr. Senator, summarize certain of the points which I have been wanting to bring out?

First I would point out the essential importance of freedom of information for the advancement of knowledge. It is exceedingly important, and I have tried to bring out some of the considerations that involve that.

This freedom of information, exchange of ideas with regard both to technical details and such things as the reasons why one needs information is all-important in bringing about the interest in carrying on investigations, the importance of emphasizing the importance, for example, of science, and the importance of bringing young men into the field of activity of science.

So I have been indicating reasons why I consider the freedom of information of importance in the advance of science and in the advance of the Nation's welfare.

I have been concerned, however, also with the question as to how the problems of security and secrecy which are essential to certain aspects of the Nation's activity can appropriately be fitted together with the advance of knowledge so that we can function most effectively as a national enterprise.

In that regard I have tried to emphasize the importance of unifying the responsibility for getting jobs done with the responsibility for seeing that the security is maintained.

In that regard I have emphasized the fact that the dominant responsibility for the maintenance of the security in a project, a national project, should be left in the hands of those who are responsible for achieving the accomplishment of a desired objective with which that project is concerned, whether that project be a matter of education, a matter of defense research, or even such things as international political discussions.

I have felt that that can be done in such a way that while the responsibility for carrying on a job is left in the hands of a certain individual that individual should have available the advice and counsel of those who are concerned primarily with the maintenance of security.

That kind of combination—putting the prime responsibility in the hands of an operator who is doing the job and a correlative responsibility in the hands of the security agency—seems to me a feasible procedure of doing things.

Those are specific matters that I have wanted particularly to bring to your attention.

I appreciate greatly the opportunity to make this statement.

Senator HENNINGS. Dr. Compton, we are greatly indebted to you as one of our foremost Americans, a great man of your time, who has responded twice to the invitation of this Subcommittee on Constitutional Rights. You have on both occasions come prepared and have devoted a great deal of time and effort to the preparation of a thoughtful, useful, and challenging statement.

And I want to thank you very much, too, Mrs. Compton, for honoring us with your presence today.

And we wish for you, Dr. Compton, during this meeting, all that you expect of it.

Dr. COMPTON. Thank you very much.

Senator HENNINGS. We know you are going to contribute greatly.

(Whereupon, at 12:16 p.m., the subcommittee was recessed, subject to the call of the Chair.)

# APPENDIX

## SURVEY OF AMERICAN NOBEL PRIZE WINNING SCIENTISTS

LETTER FROM SENATOR THOMAS C. HENNINGS, JR., CHAIRMAN OF SENATE SUBCOMMITTEE ON CONSTITUTIONAL RIGHTS, TO ALL LIVING AMERICAN WINNERS OF THE NOBEL PRIZE IN SCIENCE

MARCH 2, 1959.

DEAR ———: As part of a broad study of the subject of freedom of information, the Senate Subcommittee on Constitutional Rights is seeking to determine what effect, if any, restrictions on the free exchange of information have had on scientific development and progress in this country.

In view of your broad background of experience and knowledge, and position of eminence in the scientific community, the subcommittee would welcome an expression of your views on this highly important subject.

Your statement should prove very valuable to the subcommittee in its work, and will be included in the record of the subcommittee's study.

Sincerely yours,

THOMAS C. HENNINGS, JR., *Chairman.*

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### DICKINSON W. RICHARDS, M.D.

COLUMBIA UNIVERSITY,
COLLEGE OF PHYSICIANS AND SURGEONS,
DEPARTMENT OF MEDICINE,
*March 16, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights of the Senate Committee on the Judiciary, U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: I appreciate very much your courteous letter of March 2, inviting me to express my views on the effect which restrictions on the free exchange of information has had on scientific development and progress in this country.

No one, I suppose, would question the general proposition that science, as well as every other branch of knowledge, cannot grow without intercommunication; by conveying to the individual thinker the data and concepts that he needs for the progress of his own creative effort—whether by books, correspondence, or conversation; or that to have this creative effort as objective and as near the truth as it can be, such intercommunication must be as free, unwarped, and unimpeded as possible. Certainly in science, any such impedance acts as a detriment to the growth of knowledge.

Over against this ideal situation must be placed the unhappy reality that at the present time considerations of national security require that certain new discoveries and new knowledge must be withheld from general publication.

A just balance between these two opposing principles will be most difficult to achieve, with the situation changing from year to year, even from day to day; and one can appreciate the great problems which you and your committee have before you.

My own experience in the matter of classified information is very slight. Most of my research has had to do with diseases of the heart and lungs, and the results have been free and open to all. When Dr. Andre Cournand and I were studying traumatic shock in World War II, and again in the Korean conflict, we were dealing to a minor extent with classified information, but our research problems then were very specific, and the work was not greatly affected by restrictions in exchange of information.

In a broad sense, however, every scientist suffers when there is any restriction, at any level, to the free exchange of knowledge. Except insofar as such restrictions are absolutely required by the exigencies of national defense, we believe that there should be no restrictions. We should like, for example, to have scientists from Russia and from China visit us freely and without hindrance, we should like to discuss with them problems of mutual interest, teach them and learn from them, we should like to have their young men come and live and work with us, and if there should be a sufficient opportunity for our young men to learn, to have them go and work there.

We are not afraid of this kind of exchange; and the reason for this is that we believe that, in the last analysis, our ideology is more powerful than theirs is, more productive of true scientific achievement, more conducive to the lasting good of the human race.

Sincerely yours,

DICKINSON W. RICHARDS, M.D.,
*Director, First Medical Division, Bellevue Hospital.*

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## 2. DR. JOHN BARDEEN

UNIVERSITETETS INSTITUT FOR TEORETISK FYSIK,
*Copenhagen, Denmark, April 22, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: Thank you for the opportunity to comment on effects of restrictions on free exchange of scientific information on scientific development in this country. My own research and experience has been confined chiefly to applications of physics to the study of the properties of solid materials. In this field, exchange of information has been very free. Not only have there been few restrictions because of security requirements, but the many industrial laboratories doing research in this area usually publish their scientific findings without delay. As far as one can tell, there have to date been few restrictions imposed by other countries, so that the rapid progress made in this field in recent years has been international in scope. In particular, Russian scientists, who have been quite active in the physics of solids, publish their results and give reports of their work at international conferences. Thus, while I am unable to say very much from my own experience on the harmful effects of restrictions, I can say something on the positive side about the benefit of free exchange of information. Perhaps it may be of interest to review briefly the development of our knowledge about semiconductors, which have important applications in transistors and other electronic devices.

The basic concepts of semiconductor science were developed in large part in the thirties by scientists in England, Germany, and Russia. Work in this country at that time was confined largely to applications to electronic devices, in

which much important work was done. However, both here and abroad these applications were based on empirical art with little benefit from science. Since World War II, and particularly since 1948, as a result of research stimulated by the invention of the transition, there has been a tremendous increase in both our theoretical knowledge of semiconductors and in methods for purifying and processing materials. The gap between art and science is closing, so the designs of new devices are based much more on engineering of materials rather than cut and dry methods. What were once only intriguing theoretical possibilities on paper can now be made in the laboratory. While much remains to be done, progress made in both scientific developments and applications has been very great; much beyond what I thought possible in 1948.

This progress has required the cooperative efforts of large numbers of physicists, chemists, metallurgists, and engineers in many different laboratories both here and abroad. Rapid exchange of information has been vital to this progress. What is done in one laboratory today may depend on results obtained in another laboratory in a different part of the world only months before. For example, one of the most exciting developments of the past 3 years was made by a physicist working in an industrial laboratory in Japan. His idea was soon taken up and is now being pursued by several laboratories in this country.

With its very advanced technology, the United States is able to take best advantage of any new development in the field. The most important thing is to spare no effort so that our country remains in front and does not lag behind. We then have nothing to fear and everything to gain from free exchange of scientific information.

Sincerely yours,

JOHN BARDEEN.

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## 3. DR. WALTER H. BRATTAIN

MURRAY HILL, N.J., *March 18, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*U.S. Senate, Washington, D.C.*

MY DEAR SENATOR HENNINGS: In reply to your letter of March 2, I would like to make the following comments. Before 1939, this country had almost no restrictions on free exchange of scientific information. The only restrictions were those of private business regarding matters considered to be in the category of trade secrets and those of a personal nature in regard to premature disclosure of results of research work. Parallel with this we were a nation that offered asylum to independent and nonconformist thinking individuals. As a result, many outstanding European scientists accepted our hospitality. The large majority of them became good citizens and contributed immeasurably to our scientific strength.

Compare the above situation with that after the war. The tendency then was to classify anything scientific that might possibly aid an enemy. Attempts were even made to restrict the flow of already published information. Parallel with this we ceased to be a nation that offered asylum to intellectuals from other nations. In the larger sense, we found it impossible to distinguish between the independent thinker or nonconformist and the doctrinaire Communist. We even reached the stage where other nations offered asylum to some of our own citizens who at least thought they were persecuted by this Nation.

It would be difficult to say which is the cart and which is the horse in this situation, but I think anybody would admit that these phenomena were very closely related; that in a sense one implies the other. It also seems obvious that our behavior after the war did not help very much in eliminating or keeping out the bad apples. They seemed to operate in spite of the restrictions. The re-restrictions after the war did, however, tend to reduce our scientific potential to the extent that it did discourage top scientific men who might otherwise have come to our country.

Scientific discoveries or advances are generally made when the background knowledge has reached a level such that the new advance is just waiting for someone to see the light. Many times such breakthroughs are made by different people contemporaneously working independently of each other. One never knows just who is going to see the point or be inspired to do the key experiment. If we wish our Nation to keep abreast, the best procedure is to do our utmost to give all our scientific personnel unrestricted access to all fundamental scientific

results. I know of no means of doing this while, at the same time, restricting such information to a given nation. Moreover, any attempt to do the latter does invite retaliation on the part of others, meaning that our own scientists may not get essential information from other parts of the world. We, as a nation, have no monopoly of means to investigate the secrets of nature.

Even more fundamental to this matter is the whole philosophy of our political system. It seems to me that it is based primarily on the premise that if our citizens are well informed they will, under our system, take the appropriate political action and come to the right decision. However, we now find ourselves in a very peculiar situation. Because of security restrictions that seemed quite justified in the atomic area, our Nation is faced with very momentous decisions and since our citizens do not have access to the essential information, the basis on which our political system operates is undermined. All our citizens can do is to trust that those of our elected officials who do have access to this information will make the right decision. Does anybody want to argue that our Founding Fathers had any idea that the system they proposed would operate properly very long under such conditions as these?

I would like to make a few specific comments in the area of classified information. Any intelligent individual must admit that it is necessary to do some of this, especially in present world conditions. Admitting this, the following comments appear self-evident to me.

1. Security procedures of this nature depend greatly on the cooperation of loyal citizens. This cooperation cannot be forced, and when the procedures used are foolish, or appear to be so, one generally ceases to get the necessary cooperation.

2. Such procedures become less effective as the areas included are increased. If the program is to be effective, it must be held strictly to a very few, very important areas.

3. It only makes sense to classify information for limited periods of time. I believe we could save tremendously in paperwork if all stamps used in classifying material were required by law to include a date terminating the classification. Then at least positive action would be needed only in those cases where it became necessary to extend classification.

4. The best security is that which attracts the least attention. All security personnel that operate like advertising agents should be fired.

5. The purpose of classification is to keep the information out of the hands of those who do not need to know, but one must be very careful that one does not also keep it from those who really need it to do their job in furthering our national security. If it does the latter, then we have gained nothing.

6. It just does not make sense to classify fundamental scientific information.

As I read this over, I have a feeling that my comments are hardly adequate. I feel very strongly that most restrictions done in the name of national security turn out to be foolish. A few restrictions well considered in special areas make a lot of sense. However, the tendency always is to allow such activities to expand. As this happens the personnel involved expand, and it does not take much of this before what is being done becomes absurd, to say nothing about the tremendous obstruction it imposes on our normal ways of life. Nothing is gained if, in securing our western way of life, we lose what we are trying to secure. Don't kill the baby just to protect it from the kidnapers.

Very truly yours,

WALTER H. BRATTAIN.

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## 4. DR. VINCENT DU VIGNEAUD

DEPARTMENT OF BIOCHEMISTRY,
CORNELL UNIVERSITY MEDICAL COLLEGE,
*New York, N.Y., March 5, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: I have no special contributions to make on the subject of your letter of March 2.

In my own field of work I have not been affected by any secrecy problems. From a broad general standpoint, I believe that the least amount of secrecy, commensurate with military protection, is beneficial for the development of science in this country.

Very truly yours,

V. DU VIGNEAUD,
*Professor of Biochemistry.*

## 5. DR. WILLIAM B. SHOCKLEY

SHOCKLEY TRANSISTOR CORP.,
*Mountain View, Calif., March 31, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*Committee on the Judiciary, U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: The scope of the question posed in your letter of March 2, concerning restrictions of free exchange of information on scientific development and progress in this country, is a very serious one. However, in the semiconductor device field—in which I am chiefly occupied—very wise policies set down in 1948 have almost entirely eliminated restrictions of information flow from the point of view of military security. This leaves me in a position in which my comments on your question are based largely on hearsay and the reactions of others, rather than my own personal experience. The subject is so important that I do not feel I should express a casual opinion based on second-hand impressions. At the present time it is not practical for me to spend time in order to develop a more definite viewpoint.

In the related area of industrial security I have some definite views. It is my impression that work in the semiconductor field in this country is materially slowed down by a lack of adequate dissemination of industrial information. As a result of this I am convinced there is a great deal of duplication of effort, and techniques are developed separately and secretly in many companies in a manner which does not utilize to a maximum the scientific manpower resources involved. I believe this situation is somewhat ameliorated by work carried on on Government contracts, which do result in the dissemination of information.

I do not see how these problems can easily be answered and still preserve the virtues of the competitive industrial system we have in this country.

Sincerely yours,

W. SHOCKLEY.

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## 6. DR. POLYKARP KUSCH

COLUMBIA UNIVERSITY,
DEPARTMENT OF PHYSICS,
COLUMBIA RADIATION LABORATORY,
*New York, N.Y., March 25, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Committee on the Judiciary, Subcommittee on Constitutional Rights, Washington, D.C.*

DEAR SENATOR HENNINGS: This letter is in response to your inquiry of March 2, 1959, in which an opinion is solicited on the effect of free exchange of information on scientific development and progress in this country.

Since I have not made a serious study of the issues that are involved I am unable to make an authoritative statement. It is my impression that restrictions on free information about the results of basic scientific research have in fact, been minimal. It is in the field of technology and applications that there has been a limited exchange of information. Since my own interests have not been in applied science I can hardly evaluate what the effects of limitations have been. I doubt, nevertheless, that the fund of basic scientific knowledge that is available in this country or our own rate of progress in building up the fund of basic knowledge would have been significantly enhanced by having no restrictions at all on the exchange of information in science and technology.

Respectfully yours,

P. KUSCH, *Professor of Physics.*

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## 7. THOMAS H. WELLER, M.D.

HARVARD UNIVERSITY, SCHOOL OF PUBLIC HEALTH,
*Boston, Mass., March 18, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*Committee on the Judiciary, U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: I am in receipt of your letter of March 2 requesting my opinion as to what effect, if any, restrictions on the free exchange of information have had on scientific development and progress in this country.

Although my own interests have been in areas dealing primarily with medicine and public health, and therefore not concerned with what one might call sensitive information, it is clear that in this period of cold war the very existence of such deep-seated political conflict has an adverse effect on scientific progress. For example, about 3 years ago two Chinese doctors isolated and cultured the virus which causes the blinding disease, Trachoma. Word of this discovery reached the United States in the medical literature but was considered suspect by most virologists, including myself. Then, 2 years ago a mission of British scientists went to China and these men were convinced that the Trachoma virus had indeed been recovered Word was quickly received in this country, but I am sure the political facts of life delayed progress here about 12 months. This episode is not to be construed as being critical of one aspect of present foreign policy, but is cited as an example of the delaying effect that political differences of any sort may have on the rapid development of scientific progress.

It is to be noted that there has been marked improvement within recent months as regards the interchange of information between scientists in the health fields in the Soviet Union and in this country. In the past the flow of information has been in one direction only, for Soviet science had the wherewithall to duplicate and translate our publications. Only recently have we in the United States begun to develop a similar service. In another area one might mention the excellent and increasingly effective work being done by the various expert committees of the World Health Organization; for the most part at such meetings one sees a completely free exchange of scientific information.

Sincerely yours,

THOMAS H. WELLER, M.D.,
*Richard Pearson Strong Professor of Tropical Public Health and Head of the Department.*

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## 8. DR. SELMAN A. WAKSMAN

RUTGERS UNIVERSITY,
INSTITUTE OF MICROBIOLOGY,
*New Brunswick, N.J., March 13, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

MY DEAR SENATOR HENNINGS: I greatly appreciate your courtesy in inviting me to present my views on the subject of the effect of restrictions on the free exchange of information upon scientific development and progress in this country.

### PERSONAL EXPERIENCES

My own experiences have been limited entirely to the biological sciences, especially in the field of microbiology, and to a lesser extent to the fields of agricultural and medical sciences. I will, therefore, limit myself specifically to those fields in which I have definite information. I am, of course, also ruling out those problems that may have a bearing upon security measures.

Through my official connections with national scientific societies, through my services during the war and afterward as consultant for various governmental agencies, through my collaboration with various industrial organizations, especially in the field of antibiotics, I have had important contacts with various scientific groups and numerous individual scientists to justify certain generalizations. Although I personally seldom found, both in my formal and informal contacts, any restriction in the free exchange of scientific information, various reports reached me that such was actually the case. This was true particularly of classified information during and immediately following the war years, and of certain exchanges of information with industrial organizations. The first can be explained by war necessity and by security measures, and the second by the highly competitive nature of the industrial field, when large sums may have to be spent in the development of new drugs, for example.

I can do no better than to illustrate my own experiences by referring to my own special activities in the field of antibiotics. In 1939, or just 20 years ago, I undertook the study of a group of chemical substances produced by microbes, later designated as antibiotics, and dubbed in the popular mind as miracle drugs. At that time there were known only two such compounds, namely pyocyanase, developed largely in Germany many years previously, and tyrothricin recently discovered in this country by Dr. R. Dubos at the Rockefeller Institute. Both

of these compounds received general attention and were well known both to the scientists and to the medical profession; there was certainly no limitation in the exchange of information pertaining to them. Unfortunately, these two antibiotic products of bacterial origin had rather limited practical usefulness because of their excessive toxicity.

In 1940, two great discoveries in the field of antibiotics were announced. One was that made by Profs. E. Chain and H. Florey of Oxford University, England, that penicillin, described some 12 years previously by Alexander Fleming of London, had great potentialities as a therapeutic agent in the treatment of human infectious diseases. The other was the announcement from my own laboratory at the New Jersey Agricultural Experiment Station, Rutgers University, that the actinomycetes, a group of little known microbes offered great potentialities as producers of antibiotics that might become chemotherapeutic agents. These two announcements immediately attracted universal attention in this country.

The U.S. Government and American industry spent huge sums of money in the development of penicillin; the immediate practical results thus obtained represented an ideal illustration of the great benefits to mankind to be derived from the intensive collaboration between the scientists, industry, and Government.

The development of streptomycin is another illustration of the importance of such collaboration, although the path followed was strewn with much sharper thorns. Our discovery in 1940 of actinomycin, the first true antibiotic produced by actinomycetes, proved to lack immediate practical utilization; it was too toxic. Further search resulted In the discovery of streptothricin in 1942; this antibiotic possessed all the desirable properties of an ideal chemotherapeutic agent, especially one that would supplement penicillin; it immediately attracted attention from various scientific and industrial groups. The culture producing this antibiotic was distributed freely to all individuals and organizations, throughout the free world, who were interested in working with it. Unfortunately, this antibiotic still proved to be somewhat toxic for unqualified use. The experience that we gained, however, from the work on streptothricin enables us to isolate, 6 months later, the highly successful antibiotic streptomycin. In carrying out these investigations, I had to depend almost exclusively upon the limited funds provided by the Agricultural Experiment Station of Rutgers University, and to a more limited extent by one industrial organization (Merck & Co.). An application made to one of the U.S. Government agencies for support in undertaking this research was turned down; the reason given was that this work was purely theoretical in nature and did not appear to offer any practical potentialities. Fortunately, certain public-spirited organizations, notably the Commonwealtn Fund of New York, and the Albert and Mary Lasker Foundation, came to our support, and made the continuation of our efforts possible.

When we were successful in establishing the great potentialities of streptomycin in the treatment of numerous infectious diseases of man and animals, we obtained immediate collaboration of various scientists in the field of medical research. Drs. C. Hinshaw and W. Feldman at the Mayo Clinic and numerous others came to our aid. Various industrial organizations, notably Merck & Co., and certain Government bodies, especially the Food and Drug Administration, became vitally interested. Although the discovery of streptomycin was originally covered by a patent assigned to Merck & Co., the authorities of Rutgers University requested this company to give up its exclusive rights to this patent so as to make it available to all those who were interested in its exploitation. Before long, namely about 1946, the whole industrial organization in this country and abroad was able to take full advantage of this discovery. This led to tremendous developments, which again represent an ideal illustration of the great benefits to be derived from the free exchange of scientific information.

On the other hand, a good illustration of the failure of a discovery due to a lack of proper exchange of information is presented by "albomycin." This antibiotic was announced in the Soviet Union in 1951; all sorts of claims were made concerning its practical usefulness. But the actual facts were veiled in secrecy. It took several years before it was elucidated that this antibiotic was nothing but a form of grisein which was discovered in my laboratories in 1946, or 5 years prior to its "rediscovery" in the Soviet Union. This fully justified my statement made in Science (March 29, 1957) that:

"If ever isolationism has been dangerous in any field of science, if ever rapid development in such a field has required close international collaboration among different scientific groups, it has been particularly true of the study of antibiotics. The study of the formation, isolation, chemical identity, and biological activities of these microbial products requires rather specialized procedures in biology and

biochemistry. * * * One of the most striking illustrations of the need for close collaboration in this field was recently presented by the isolation in four different laboratories in the United States and in Western Europe of preparations which, on careful comparison, proved to represent the same chemical and biological entity. This could be established, not only by a comparison of the physical and chemical properties of the preparations, but even more simply by the use of organisms of known sensitivity to different antibiotics. Developments in the case of grisein and albomycin would seem to provide an equally striking illustration."

The conclusion was reached that:

"Research on new antibiotics is engaged in at present throughout the world with such intensity that one must be able to compare cultures of organisms producing such antibiotics, as well as the isolated substances themselves, if one is to avoid needless duplication and great confusion. As long as no international center exists where such comparisons can be made, only close collaboration among scientific laboratories can make possible these essential comparisons. The repetitions and the frequently unjustified creation of "new species" of antibiotic-producing organisms and of "new antibiotics" can be avoided only by close collaboration among the scientific workers throughout the world. The creation of an International Antibiotics Board is also highly essential at the present time."

The principles laid down in the development of penicillin and streptomycin, notably in the United States and Great Britain, have paved the way for the tremendous cooperative efforts that followed in the field of antibiotics for the improvement of human health in all the countries of the world.

### EXPERIENCES OF OTHERS

One hears of various instances of the demoralizing and stultifying effects of secrecy on scientific work. It is sufficient to cite the following illustrations:

A highly secret investigation involved protection of human beings against the possibility of the use of anthrax spores in bacteriological warfare and their cure in case of such use. A competent group for this study was assembled. One of them, the late Dr. Louis A. Julianelle, soon found that mice, infected with anthrax could be cured by injections of penicillin. Security regulations prevented publication of this important finding. However, bacteriologists at the Mayo Clinic, working without an official mandate and unhampered by Government-imposed secrecy, soon announced the same discovery to the newspapers and later published the results in a scientific journal. The policy of secrecy thus deprived Dr. Julianelle of credit for his prior discovery and caused bitterness and frustration.

Another secret investigation dealt with protection of man against the toxin of the castor bean, ricin, which was considered a possible agent of chemical warfare. While struggling with the difficult problem of immunization against this terrible poison, Dr. Michael Heidelberger and his group succeeded in getting much purer preparations of ricin; two other laboratories actually crystallized it. At the end of the war, as the result of an address by a general, secrecy restrictions on this portion of the work were lifted. The investigators involved wrote up their work and sent it off for clearance, which was granted to one investigator. However, before the others had completed their papers, the restrictions were clamped on again. The first paper was published with the footnote stating in whose laboratories ricin had been crystallized, but the biochemists who had actually achieved this were not allowed to describe their results or even tell anyone about it until another year or two had elapsed.

Another comment that one frequently hears is that classification and other restrictions on the free exchange of scientific information has a most frightening effect on the scientific community at large. Many scientists feel such classification is wrong and unnecessary in most instances. This is evident at scientific meetings where personnel employed in classified areas complain of the unavailability of qualified people who will not join their ranks because they are conducting classified work. Another complaint is that because of the undesirable environment created that classification has the potential danger of hiding mediocrity. One has no way of knowing what the loss to the scientists of the Nation is in not having access to information which is needlessly classified.

It has been suggested that it would be desirable to establish a more decisive distinction in security classification between the Government's efforts in the area of (*a*) research and (*b*) development. Thus, much, or possibly all, fundamental Government research might be freed of security restriction, whereas, of course,

developmental research in many areas may have to remain classified for varying periods of time. Although it is recognized that administrative problems may arise in connection with such separation, the benefit to basic research would be considerable. At the present time, even basic research endeavors of relatively low security classification, designated as "restricted," suffer from the restriction imposed in relation to public dissemination of accumulating information. These restrictions, i.e., clearance prior to public dissemination, appear to apply both to essentially unclassified research in Government installations as well as to unclassified research carried out in universities and industry under contractual arrangements with governmental agencies. These restrictions not only delay publication and oral presentations of accumulating data, often to a point of critical disadvantage to the problem's pursuit and the investigator's stimulation and priority, but it also restricts the useful free discussion of work in progress on unclassified Government projects. Delays of clearance of essentially unclassified scientific material due to administrative bottlenecks have led at times to an inability to present a paper at a certain scientific meeting, and discuss the material until clearance for publication has been obtained. It has discouraged a number of creative scientists from participation in "unclassified" Government research contracts.

I hope that the data presented here will be of use to your committee in clarifying the problem of the effect of the restrictions on the free exchange of information upon the scientific development and progress in this country.

Respectfully yours,

SELMAN A. WAKSMAN,
*Professor Emeritus.*

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## 9. DR. FRITZ LIPMANN

THE ROCKEFELLER INSTITUTE,
*New York, N.Y., March 5, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Senate Committee on the Judiciary, Subcommittee on Constitutional Rights, Washington, D.C.*

DEAR SENATOR HENNINGS: It is only possible for me to speak about the field of biochemistry in which I feel I have enough competence to offer an opinion. I think that this field is relatively little touched by restrictions on the freedom of information in scientific research.

At one time, however, I was interested in and had a little contact with the work going on at the Chemical Warfare Center on the mechanism of the so-called nerve gas poisoning. Some of their work was published and showed that the poison attaches to the active center of an enzyme (enzymes are the biocatalysts that are responsible for the flow of metabolism in living beings). This has been very valuable in stimulating further work on the mechanism of enzyme action. In this connection, I have heard complaints from the very able workers at this center who worked on the problem of prevention of poisoning which dealt with the release of a fixed poison from an active enzyme center. It appeared that some of their most interesting results became obsolete and outdated because other groups in unrestricted research freely published work on similar lines.

This small and relatively unimportant episode shows that generally there is very little to gain in restriction. In a much worked-upon field, information will not remain secret for long, not because of leaks but because others will think on similar lines. This is how research works. Similar approaches generally develop in various places at one time and it is, at best, only a matter of time before restricted knowledge will become general knowledge.

However, such instances damage the morale of the scientific worker, who rightly feels that his work should be recognized by his colleagues, and who is unhappy if he loses the acknowledgment of success due to some sluggishness in releasing and, indeed, restricting projects.

I would summarize my impression of this problem with which, I have to emphasize again, I have had very little contact, that it might be good to recognize that restrictions should be restricted to the really worthwhile items and should sometimes be handled very advisedly.

Sincerely yours,

FRITZ LIPMANN.

## 10. DR. FELIX BLOCH

STANFORD UNIVERSITY,
DEPARTMENT OF PHYSICS,
*Stanford, Calif., April 16, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: I am sorry that I was not able to give an earlier reply to your letter of March 2, 1959. The question of the effect of restrictions on the free exchange of scientific information is a very important one. In order not to express a too one-sided opinion, it seemed advisable to me to solicit comments of some of my colleagues at Stanford and this took me some time.

Broadly speaking, it has to be stated that a lack of free access to information is always and necessarily harmful to scientific progress. Modern science is a cooperative enterprise in the sense that every advance is based upon previous work of others and that it frequently requires the knowledge of a large number of facts, collected in several laboratories over a prolonged period of time. One might argue that it is sufficient, in any given phase of research, to be in possession of the relevant facts alone. The fallacy of this argument lies in the circumstance, that it can rarely be determined in advance which selected part of the existing information will prove to belong to this category. It is often the combination of apparently uncorrelated data, the use of techniques, developed in other fields and the stimulus, arising from the study of entirely different problems, which leads to new discoveries. The element of surprise is inherent in every major step forward and it is endangered by narrowing down the sources of information.

To quote a specific example in which I have firsthand experience, I want to mention the circumstances under which I made the discovery of nuclear induction. My previous work had been in the field of atomic and nuclear physics and it was only my occupation with radar problems during the war which made me familiar with the, then, highly restricted information of radio techniques. The discovery consisted in the application of these techniques to some properties of atomic nuclei and could not have been made without the knowledge of both. It occurred to me only because I worked fortuitously in one of the many small and separated compartments of war research which happened to contain the information which I needed.

The restrictions on scientific information, although vastly overdone even then, were understandable during the war, but they have been carried over into the postwar period and are still too effective. It is true that a considerable improvement has occurred in the past few years but there exists the danger of a reversed development and there are still undesirable features in the present procedure.

The principal weakness of the system is the manner in which the research of a whole group is sometimes summarily classified without due regard to the necessity for classification. It would seem that classification is called for only if the work is not only of direct military value but also if this value is quite immediate. To quote again an example, neither of these conditions was fulfilled in the case of Project Sherwood to achieve controlled thermonuclear reactions. Nevertheless, after having been taken over by the Atomic Energy Commission, it was classified. In spite of voices, advocating almost complete declassification, this was not achieved until January 1958. There is little doubt that this delay not only caused unnecessary duplication but that it also prevented men outside the project, but with interests in the field, to make contributions.

There may be persons who admit the harm done to our own scientific progress, but feel that severe restrictions of our scientific information does even more harm to competing nations and is therefore to be welcomed. It would be difficult to discuss this argument on a rational basis but it certainly expresses a defeatist attitude and a lack of faith in the potentiality of American science which is not justified by its remarkable performance.

Hoping that these remarks are of some value to you and with my best wishes for the successful work of your subcommittee, I am

Very sincerely yours,

FELIX BLOCH,
*Professor of Physics.*

## 11. DR. GLENN T. SEABORG

RADIATION LABORATORY,
UNIVERSITY OF CALIFORNIA,
*Berkeley, Calif., April 2, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*Chairman, Committee on the Judiciary, Subcommittee on Constitutional Rights, U.S. Senate, Washington, D.C.*

SIR: In sending you my comments on the role of free exchange of information in the progress of science, I shall confine myself to fundamental research which lays the groundwork for practical technological developments.

I think that if there is any conclusion upon which all scientists have complete agreement it is that exchange of information is vital for maximum progress and elimination of waste motion. Also, since, among human pursuits, science is almost unique in being immediately transferable across national boundaries, exchange of information must be considered on a global basis. As chairman of a committee of the United States Senate, you are properly concerned with the implications of free international exchange of information on our position as a Nation. Contrary to what one might guess, it is the nation in which science is already flourishing that stands to gain greatly. The probability that a new idea or development in methods can be exploited in generating new ideas and developments is proportional to the number of receptive ears which hear about it and to the adequacy of facilities for doing something about it.

There are two time-honored means by which information is exchanged in science. One of these is the large body of technical journals in which original research is published and disseminated. It is my opinion that this avenue of communication is now rather freely open on an international basis.

The other general pathway is by direct exchange between individuals: Personal letters, attendance at scientific meetings, short visits, and long visits in which a scientist actually works in another laboratory for a period of months or years. It is here that I strongly feel we can and should do much better. The great importance of personal contact as an adjunct to publication could be discussed at length. I shall just touch on a couple of points. In the first place, there is often a great time lag in publication. It is important to know what people are thinking about and building now, as well as what the situation was a year or more in the past. I should also mention that an item of great importance may never get into print because its significance for the author's particular purposes was minor. Finally, and of greatest consequence, is the fact that the true flavor of how a piece of work is done can seldom be tasted from the dry distillate of the published results.

In this context, I would like to tell you of something in particular which is causing me considerable concern. This is the virtual absence of easy, direct communication with scientists of the Soviet Union. The publications avenue is, for us, severely cramped because of our general illiteracy in the Russian language. Russian scientists do not have the reciprocal problem because they virtually all read English and, in addition, have an efficient and comprehensive translating service. It is my considered opinion that we are being derelict in not taking the initiative in establishing broader means for direct contact and exchange on as informal a basis as possible.

We should also take steps to establish similar relationships with all countries of the world, including Poland, Czechoslovakia, and China. If we do not get a proper perspective on the development of science in countries such as China, we shall not be able to act rationally and will surely suffer a rude awakening in the not-too-distant future.

It should be plain to all that great national prestige is now associated with a nation's vigor in fundamental research. It is important that we not only support our research adequately but also that we comport ourselves in accordance with the traditions of free inquiry and dissemination of knowledge. In recent years we have received extremely unfavorable publicity in the scientific community through our policies pertaining to visits by foreign nationals. Various visa restrictions, non-Communist oath requirements, and finger printing have been distasteful to scientists of Western Europe and have even restricted the entry of eminent scientists to the United States for the purpose of attending meetings. I think it

is fair to say that a whole generation of influential French scientists has grown up with a feeling of dislike for the United States because of these restrictions. A number of international societies a few years ago had a rule that the United States was "out of bounds" for meetings and, as far as I know, this may still be the case. I do not know in detail how many of the travel restrictions have been eased, but I do know that the belief in their existence is still doing its damage.

In closing, I would like to add a comment which goes beyond the area of science and probably beyond the purview of your committee. Since I have become chancellor of the University of California, Berkeley, I have, of necessity, thought more broadly about education and the role which it will play on local, national, and international levels. It is my conviction that one of the crucial steps to be taken in the world conflict of ideas is that the western concepts of freedom of inquiry be established in all of those nations which are emerging from a status of subservience. Concretely, I would like to see us furnish the modest financial support and the loan of scholars needed to establish schools of higher education wherever such universities are welcome.

Sincerely yours,

GLENN T. SEABORG.

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## 12. DR. EDWIN M. McMILLAN

RADIATION LABORATORY,
UNIVERSITY OF CALIFORNIA,
*Berkeley, Calif., March 23, 1959.*

THOMAS C. HENNINGS, Jr.
*Chairman, Subcommittee on Constitutional Rights, Committee on the Judiciary, U.S. Senate, Washington, D.C.*

DEAR MR. HENNINGS: I do not believe that restrictions on free exchange of information are now much of a problem in purely scientific fields. They were once a very serious problem, but the situation has been largely relieved by a sound program of declassification.

The relief has not been quite complete, however, as illustrated by the awkward situation created by the failure to release the scientific results of the Argus experiment at an earlier date.

In the fields of applied science, I have less direct knowledge, but I have a rather strong feeling that the situation is not as good. The problem lies in the relation between "classified information" in the AEC sense and "proprietary information" as understood by commercial organizations working under AEC contracts. This relation probably needs further clarification.

Sincerely,

EDWIN M. MCMILLAN, *Director.*

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## 13. DR. EDWARD C. KENDALL

PRINCETON UNIVERSITY,
THE JAMES FORRESTAL RESEARCH CENTER,
*Princeton, N.J., March 16, 1959.*

Hon. T. C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: In reply to your letter of March 2 it would be a pleasure to place before you a comprehensive review of achievements in physics, chemistry, biochemistry, and medicine and to tabulate the physical equipment and the psychic environment of the laboratories at the time that the contributions were made.

Such a report would reveal that many outstanding contributions to science have been made in laboratories which were poorly equipped with apparatus. On the other hand the work was carried out by men who possessed, to a marked degree, the human characteristics of faith in the project, devotion to research, persistence, and ability to adhere to a program which had a fixed objective.

High among the essential conditions for the most efficient research work is freedom of information. Frequently the key item which leads to a so-called breakthrough is based on a word, suggestion, or some product which had its origin in another laboratory and was made by wholly independent workers.

The objective of all creative research is to enlarge the horizon which circumscribes the fund of knowledge in the world of science. The best situation in the

best of possible worlds would be rapid dissemination of all new work. The information thus made available would, of itself, be a powerful stimulus. This would lead to a constantly increasing acceleration and would indeed be the tangible evidence of what Prof. Charles Beard has cited as the "invention of invention."

As a dismal contrast one merely has to go to the other possible extreme. In such a world, investigators in all research laboratories and medical institutions would work behind locked doors. No results would be published, all workers would be isolated, all publicity by the association of science writers would be suppressed. Interest in science would decrease, the tempo and scale of research would slow down, a feeling of indifference and hopelessness would crush initiative, a moratorium on progress would ensue.

The remarks already recorded are concerned with creative research. The goal of every experiment is to add some large or small item to those things we know to be true. Out of such work will come many new applications. To develop and exploit these in a useful way new methods of manufacture will be required. This will result in the accumulation of know-how which, in this field, is the secret of success.

Today, life goes on in a world divided into two large and many small parts. Even so, I believe that the policy which governs research work should be complete freedom of information.

But know-how in the commercial world is quite a different matter. The manufacture of the fruit of research requires protection. Know-how should be safeguarded; it is America's heritage which has come to the present generation by virtue of the men of genius who lived before our time.

I believe that with freedom of information in the field of creative research and with protection of methods of manufacture for applied research the United States can advance against all competition and maintain its place of leadership of freemen throughout the world.

Sincerely,

EDWARD C. KENDALL.

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## 14. DR. PERCY W. BRIDGMAN

HARVARD UNIVERSITY,
DEPARTMENT OF PHYSICS,
LYMAN LABORATORY OF PHYSICS,
*Cambridge, Mass., March 6, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

MY DEAR SENATOR: In reply to your inquiry of March 2 with regard to the effect of restricted freedom of information on scientific progress I am glad to make what comments I can because I regard the matter as of the greatest importance.

Every scientist with whom I am acquainted regards any restrictions of secrecy which may be imposed on him with regard to the communication of scientific results with the utmost distaste. Complete freedom is the essence of true science. It is unthinkable that a scientist would recognize any limitations in the technical means that he would adopt to solve his problem. Part of his method of solving a general problem consists in discussions with his fellow scientists—this may be for general purposes of stimulation that comes from fresh contacts and for more particular reasons connected with the specific suggestions which his fellow scientists may be able to make. If I, for example, think that my colleague may be able to make some helpful suggestion for my experiment, I can feel it only to be highly irrelevant that he may not have secured clearance by the FBI. It goes against the grain to realize that there are closed areas of communication between us. In purely technical matters I think most scientists realize that there are practical considerations which may make secrecy necessary, but with regard to purely scientific matters I think no scientist willingly accepts restrictions, and I furthermore believe that most scientists feel that many such restrictions have been unnecessarily imposed.

The scientist feels so strongly about this that I believe it may well be a decisive factor deterring a young man about to choose his career from entering a subject subjected to such restrictions. A manifestation of this same feeling is the decision of Harvard University, and of other universities also, not to engage in any work with Government money under Government contract which was not freely publishable. I myself have not had close connection with Government work, but in one instance

I was decisively influenced by considerations of this sort. At the close of the war I declined to continue work under Government contract on a subject of some real scientific interest to me because I found association with the Government, and in particular the probability of secrecy restrictions, too distasteful.

Yours sincerely,

P. W. BRIDGMAN.

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## 15. DR. EDWARD A. DOISY

ST. LOUIS UNIVERSITY SCHOOL OF MEDICINE,
*St. Louis, Mo., March 11, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: In reply to your query, I am convinced that freedom of communication is the lifeblood of progress. Invariably new discoveries are dependent upon scientific work which has been published previously. Even the epochmaking advances have made use, either directly or more remotely, of earlier scientific reports.

In my opinion, the rate of progress in science depends upon the backlog of information. Accordingly, it is inimical to the advancement of science to obstruct the free flow of information between scientists.

Sincerely yours,

E. A. DOISY.

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## 16. WILLIAM P. MURPHY, M.D.

BOSTON, MASS., *March 10, 1959.*

Mr. THOMAS C. HENNINGS, Jr.,
*Chairman, Committee on the Judiciary, Subcommittee on Constitutional Rights, U.S. Senate, Washington, D.C.*

DEAR MR. HENNINGS: In replying to the question in your letter of March 2 as to "What effect, if any, restrictions on the free exchange of information have had on scientific development and progress in this country," I assume that you refer to free exchange within this country rather than internationally.

My work in science has been limited to the field of medicine wherein there is a high degree of exchange of information so that there is little or no interference on scientific development and progress in this country. Although I cannot speak from personal experience of limitations in other fields of science, I have followed rather carefully the published discussion of the problem in other fields.

It is my impression that the effect of restrictions on the free exchange of information on science developments is at least somewhat exaggerated and that it is actually rather minimal. Much of the complaint has come from a few physicists who are perhaps influenced by a more radical group who are more vocal in their objections because of their basic beliefs.

It is my believe that restrictions should be continued and perhaps increased in those branches of science which are concerned with the sensitive areas of scientific development where restriction may be more important than would be the benefits which might be derived from the free dissemination of information.

Sincerely,

WM. P. MURPHY.

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## 17. GEORGE H. WHIPPLE, M.D.

THE UNIVERSITY OF ROCHESTER,
SCHOOL OF MEDICINE AND DENTISTRY,
*Rochester, N.Y., March 6, 1959.*

Senator THOMAS C. HENNINGS, Jr.,
*Chairman, Subcommittee on Constitutional Rights,*
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: I have your letter of March 2 and am glad to reply. In my opinion, there can be no doubt that restrictions on free exchange of information have an unfavorable effect on scientific development, research, and progress. I realize that there must be restrictions placed on certain types of information, but, from my own experience, I am confident that many of these

restrictions serve no useful purpose and do interfere with scientific development. This relates to university research, teaching, and related training of young scientific workers. It is a very complicated subject and I sympathize with any committee dealing with these problems where rules must be put down on paper.

If I can answer any specific questions, I hope you will call on me.

Very truly yours,

GEORGE H. WHIPPLE, M.D.

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## 18. DR. HAROLD C. UREY

UNIVERSITY OF CALIFORNIA,
SCHOOL OF SCIENCE AND ENGINEERING,
*La Jolla, Calif., July 2, 1959.*

Hon. THOMAS C. HENNINGS, Jr.,
*U.S. Senate, Washington, D.C.*

DEAR SENATOR HENNINGS: In answer to your recent letter, I am enclosing herewith a reprint of my address on "Scientists, Secrets and Security," published in The Chemist, January 1955.

Sincerely,

HAROLD C. UREY.

### SCIENTISTS, SECRETS AND SECURITY

Dr. Harold C. Urey, Institute of Nuclear Studies, University of Chicago, Chicago, Ill.

(Acceptance address when the author received the Honor Scroll of the Chicago AIC Chapter at a dinner on October 8, 1954, in Chicago, Ill.)

The problems covered by the subject of this paper have plagued scientific people ever since the war, and all of us have hoped that in some way sane and sensible discussion of the subject would be possible. As time has passed, we have observed that the annoying procedures of wartime have grown to be far more irritating, and the discussion of the subject by the press and public seems to me to become less and less rational. This is probably partly because the public does not understand the nature of scientific facts, but also I suspect it is because of the decreased security of this country relative to foreign attack that has occured during this century. We are all appalled by the dangers to us arising from the invention of nuclear weapons and the development of airplanes during this century. The continuous developments in both fields with no very obvious limitations in the future have given the people of this country a first class case of hysteria.

I believe we as a nation are in a more dangerous position than we have ever been in since the time of our own Revolution. There is an implacable enemy to our way of life in the world today. We are not at all the only people who face this situation; some other democratic countries are in even more dangerous positions than we are. But to us the situation is a new one, whereas it has been almost a normal one for some other countries, for example, in Western Europe. For this reason we may become much more perturbed than they do. Also, it may be that people do not discuss such imminent dangers as those of Western Europe continuously, whereas people who are somewhat more removed, as we are, find that it is possible to discuss them just because it may be possible to do something constructive about them. However, this may be, the discussion of our difficult world situation is continuous in this country, and much of the discussion deals with trivia rather than with the really important problems of the situation. At the same time our position as the most powerful nation of the free world requires that we do consider these problems with courage and calmness.

#### THE PROBLEM OF SECURITY

By security I mean some degree of safety for this country against military attack from without, violent revolution from within, and subversion of our democratic institutions by other means. This broad security is a very complicated problem and depends on almost all activities of people within the country. To review all factors of this security would require a very large document, but I wish to outline some features of security in order to discuss scientists and secrets in a proper perspective.

The 19th century was the golden age of the United States from the standpoint of external attack. The Atlantic and Pacific Oceans were extremely broad in those years, and we were indeed isolated. Then isolationists had all the arguments on their side. We also were not endangered by any foreign revolutionary ideas. As a matter of fact, we were the revolutionary idea of the century and were greatly feared on this basis by some other countries. In fact the ideas of our Revolution resulted in important changes in governments in Europe. But this disturbed us not at all and we viewed these changes in much the same way that Communists view the spread of their doctrines today. We really were happy about the whole thing. But today our isolated military position is gone. It went at the turn of the century with the invention of the airplane, and today we fear attack from across the Arctic Ocean. Who would have dreamed of this when a machine flew at Kitty Hawk? None of us really realized this until somewhat later, and many people today act and talk as though we were living in the happy days of 1900. Also, a new revolutionary set of ideas has come to prominence in the world, and I am sure that we belong to the conservatives in connection with these ideas. I believe that our old revolutionary ideas are superior to the new and that they will serve the world in the future as they have in the past.

It is impossible to talk of external and internal security of a country unless certain fundamental conditions exist. A certain social, political, and economic stability must exist within the country. This depends on the psychological state of the people of the country and such a state depends on their past history, their cultural history, and their religion. It is a sort of internal feeling of well being of the body politic, analogous to a similar feeling on the part of the individual citizen. Political, religious, and economic arguments must not become too violent and there must not be a widespread feeling that great injustice exists for a substantial fraction of the population.

Such a satisfactory condition exists in this country and many other free countries of the world. Some people in this country have been very angry at some governmental developments of the last 20 or 25 years, but I do not believe that these cries of treason really represent a deep-seated split in the population. On the other hand, the situations that exist in France and Italy do come close to causing great weakness in these countries. Nothing remotely approaching such a situation exists in this country. We will always have extremists of various kinds, but as long as the overwhelming majority regard conditions as acceptable even if decisions are not always as they would like, we have a secure basis from which to construct our external and internal security. (I wish sometimes that fewer people talked as though this essential stability in this country did not indeed obtain.)

In particular, the United States is exceedingly stable with regard to Communist ideas and philosophy. We probably have some 25,000 or 50,000 Communists in this country and about 10 times this many people who are insane enough to be confined in institutions. We also have a considerable number of people who would readily subscribe to a totalitarianism of the right. But all categories of such people are very limited in number. There is not the remotest possibility of the number of Communists increasing in any important degree. Communism appeals to people who are socially and economically on the wrong side of the railroad tracks, i. e., without satisfactory jobs, social position, and opportunities. There just is a vanishing small fraction of our people who are in this situation or who do not see the unfavorable situations changing.

I feel less certain about our fanatics of the right, perhaps because I do not know what it is that makes them what they are. Why are people who are on the right side of the tracks socially and financially sometimes anti-Semites and antiminority groups generally, and why are they willing to discard all democratic procedures in order to attain ends which really do not benefit them at all but make other people miserable? Why did Hitler wish to exterminate 6 million Jews?

But in spite of these insane groups at the fringes, this country is solidly middle-of-the-road democratic, and I do not believe that these minority groups have any possibility of undermining this country. I am not concerned about our teachers, our political leaders, our religious leaders, or anything in this connection. All imperfections are minor and of small consequence. I emphasize this as strongly as possible and I wish the people of this country could be brought to realize it. Their approach to all problems would become more confident and more sensible. In this troubled world situation we "lead from strength."

But in other nonmilitary ways we have considerable strength. The ideas of our own Revolution have partly influenced much of the free world as other countries and peoples have spontaneously evolved along similar lines. Our ties to the British Commonwealth of Nations are very genuine even if entirely in-

formal. Similarly our ties to the free countries of western Europe are very strong. My wife, my son, and I have just returned from 2 months in Norway, Sweden, Denmark, France, and Italy. We liked the people, the food, the cathedrals and antiquities. But most of all, we found the general political conditions so similar to those in our own country. The police will protect us and not persecute us. If we ran afoul of the law, we would get very similar treatment to that given us here. We moved freely about the cities and countries. During the last centuries these countries and others have moved along very similar lines of development to those followed by ourselves. We are allies in very fundamental ways. We cherish the same political customs, the same religious views, the same literature and art, and look back to the same ancient historical cultures of Greece, Rome and the Hebrews as the inspiration of our own. We also have endured recent wars together. We are trying desperately to construct measures of mutual defense against militant and tyrannical communism. Our attachment to these people is an important part of the 20th century security of the United States.

Since the war, I have devoted some effort toward extending the American revolutionary idea of federalism to these western democratic countries. * * * It seems to me that most of our international problems could be handled more effectively if the western democracies created a united supergovernment of limited powers of a Federal type to take care of defense of all our liberties. Much support for the Atlantic Union idea exists in this country. Senator Kefauver has been a stanch supporter of this idea and was attacked in his recent campaign for his stand. His last words to the people of the State of Tennessee on the night before election were, "I am for Atlantic Union." He won over his opponent 2 to 1. I am sure that France and Western Germany would both join such a union, whereas it has proved to be impossible to get the French into E.D.C. We Americans should have our own revolutionary ideas based on our own history. They could be extended to a wider community and would give us greater security.

Finally, we should mention the purely military contributions to security. Without this I am convinced that no security exists for this country in the middle of the 20th century. It is unnecessary in this group to emphasize its importance. India may accomplish much by passive resistance, but I do not believe this will suit us in the slightest. And military matters involve some things which are scientific and engineering in character as do, as we well know, most of our nonmilitary activities. And this circumstance brings us into the problems of secrecy.

No scientist of my acquaintance questions the need and advisability of keeping secret information that pertains to military matters. The difficulty arises in regard to the line where secrecy begins and in regard to the amount of effort which should be put into keeping scientific things of this sort secret. It is always a losing battle, for all scientific knowledge can be learned independently by a technically advanced enemy, quite independently of any leak of information from us. It may also be said that espionage can supply no information to people who have no technical knowledge. The Russians seem to have discovered the cheap hydrogen bomb before we did (my authority is Sir Francis Simon). Such people can profit from espionage. On the other hand, the Indians of the Amazon Valley could be supplied with any amount of information and would learn nothing. Only if a country has approximately sufficient technically trained men to discover things for themselves is it possible to transmit valuable knowledge to them. Mostly the Russians developed their own bomb.

What fraction of our effort should be concerned with keeping our military scientific secrets really secret? This entire address up to this point has been given with the idea of making an estimate. Security for this country depends on many things of a nonmilitary character. Of the military category only a part concerns technical matters. Of technical matters much deals with the operation of machines of many kinds and these are kept secret only partially at best because of the large number of people involved. Much of scientific effort must be devoted to discovering, inventing and developing new defensive and offensive devices. Interference with these efforts costs us dearly from the standpoint of security.

I suggest that less than 1 percent of the personnel of a military research laboratory should be concerned with all the mechanical details of keeping information secret. I rather think that this may be a proper estimate of what effort is devoted to this problem. Also I suggest that the appropriations for the FBI are large enough to deal with subversives, etc. In fact, I believe this agency could do a better job if some of the investigative duties assigned to them were discontinued. The entire field of secrecy, either of scientific or nonscientific matters, should not concern the average American citizen to more than about 1 percent of the time that he gives to his responsibilities as a citizen. He should rather give his

attention to the problem of a substitute for EDC in Europe, a proper solution to the Indochina problem, a proper foreign policy for the United States, etc. How many of our citizens do this? How many of us have devoted 99 percent of our attention to governmental problems to questions of this kind during the past year? I for one have not. I have thought and talked about—well, you know what. The same things that you talked about.

The problem of proper secrecy in military matters exists. It is a small problem in the overall problem of security for this country.

Incidentally, much attention is given to this problem, but I wonder if the attention is mostly not due to our sadistic tendencies? The Romans liked gladiatorial combats. We really enjoy in a way seeing the wicked or perhaps even the innocent suffer. I feel sure that the attention in the press given to accusations against people, whether true or false, is due to our basic cruelty. Isn't it at least partly a substitute for the Roman arena that we seek?

Don't misunderstand me. I believe that the importance of secrecy and espionage is greatly exaggerated. However, I have no illusions in regard to the detrimental effects of this exaggeration on our own activities and our position of leadership in the world. We are being laughed at by some and almost abhorred by others whose good opinions we need, and indeed had a short time ago.

### SOME PROBLEMS OF IMPORTANCE IN SCIENCE AND SECURITY

Among all the diverse problems relating to this important problem of security for this country at this time, there are some that we as scientists should think about. Many of our fellow scientists in spite of public criticism do continue patiently to study military technical problems without expecting or receiving public recognition or any additional financial reward. These efforts we hope will be negative, i.e., that the devices will never be used. Still the work must be done.

But I often wonder how long this will continue to be true as case after case of denied clearance occurs. This has been going on for a long time. Many little people have been denied clearance and mostly we hear nothing about them. Sometimes the men have appealed to me for help and I have never known of anything I could do. For years Dr. Edward Condon has been forced to defend himself against public accusations and in formal clearance hearings, but he has always been cleared for secret work as far as I know. The most celebrated case is that of Dr. Oppenheimer. This case has been discussed until there is nothing new to say. I do not believe that Oppenheimer ever intentionally damaged the security of the United States. Rumors come to us that other people will be summoned for clearance proceedings. A book has been published attacking large numbers of scientists who have worked on the hydrogen bomb. Gordon Dean has denounced the book as completely unjust, and indeed as false. If this continues how do we recruit new scientists and engineers, not only for military work but for any kind of scientific and engineering work?

Let us look at this problem in outline at least. How about primary and secondary schools from the standpoint of production of technical people? Most of us in this room have expressed our dissatisfaction many times in this connection, in private at least. Fundamentally, how can we expect good schools with inadequate school plants and inadequate salaries for teachers? We treat teachers as though they were inferior human beings instead of as among the most important of professions. This has gone on for many years until today there is a lack of teachers of any qualifications. It is no longer a matter of securing men and women of ability, training, and personality. It is a matter of getting anyone at all to do the job. The science teacher is usually the athletic coach. It is time we think of this problem.

Do we attract a substantial fraction of the people who have natural ability in the exact sciences into college? Or do they become mechanics of one kind or another? The wages of labor, due to effective union activities, do keep up with the depreciating value of the dollar, whereas scientific, engineering and professional salaries do not. And once attracted to college, do the students secure an adequate scientific training? Mostly industrial and Government laboratories pay better salaries, and it is difficult to find capable professors for our colleges at the present time. Some offers that I have seen during the past years are pathetic. We face in this country a near-crisis in training scientists and engineers.

Are these adequate incentives for young people to enter technical professions at the present time? I see many young people starting the long road to a competent scientific career, 4 years of college and 3 to 4 years for a doctoral degree,

and then some time spent in acquiring experience after this. Surely, public hearings for prominent scientists are not encouragement in this direction. Such appellations as "egg head" applied to all intellectuals including scientists and engineers are no inducement either. I believe that science is still sufficiently glamorous to attract large numbers of young men, but I begin to wonder what I would have done in 1914 if conditions had been similar to what they are now.

A lack of scientific and engineering talent may go completely unnoticed for years simply because we cannot see something that does not exist. Men calling themselves scientists will continue to be graduated and employed, but are they the best that we could produce? We never know. If Planck had not proposed the quantum theory in 1899, when would it have been proposed? If Bohr had not given that first push to the theory of the atom, who would have done it? I am convinced that if we do not do a better job of training scientists and engineers, work which might be done in the United States may well be done in some other country—and that country might not be friendly to us.

Efforts to improve our educational system and the conditions under which the best minds of our country work are likely to require diligence and great perseverence. They will require hard work and it will not be nearly so exciting as turning a bull into a china shop. We as scientists are accustomed to persistent work, and might well devote our efforts to such problems instead of helplessly wringing our hands or aiding and abetting some of the disruptive activity of shortsighted people.

SUMMARY

The maintenance of the security of the United States and the free democracies of the West is by all odds the most important problem facing the people of the United States at the present time. The problem of such security is a very complex one, involving the entire life of the country and its relation to other democratic countries. Military defense is an important part of maintaining security. Scientific discoveries and developments are important in military effectiveness, and it is important that such processes remain secret as much as possible without impairing the overall effectiveness. Perhaps this secrecy has an importance of 1 percent of the total effort but hardly more. The general public should hardly know that the problems of secrecy and espionage exist. Much more important for general consideration are the means of improving our general education for scientific men, as well as scholars in other intellectual fields. It would be well for the people of this country to turn from the Roman circus antics of pillorying scientists and hunting Communists and subversives to the less spectacular job of improving education in this country.

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